WORKS OF PROF. F. W. WOLL.

A Handbook for Farmers and Dairymen. Sixth Edition. New York, 1914. xv+490 pp. $1.50.

Grotenfelt's Modern Dairy Practice. American Edition by F. W. Woll. Third Edition, Revised. New York, 1910. 286 pp. $2.00.

A Book on Silage. Second Edition. Chicago, Ill., 1900. 234 pp. (Out of print.)

Decker's Cheese Making, Domestic and Foreign. Fifth Revised Edition, by F. W. Woll. Madison, Wis., 1913. 211 pp. $1.75.

Jointly with Prof. E. H. Farrington.

Testing Milk and Its Products. Twenty-second Edition. Madison, Wis., 1914. 297 pp. $1.25.

A HANDBOOK FOR FARMERS AND DAIRYMEN

BY

F. W. WOLL,

Professor of Animal Nutrition. University of California

WITH THE ASSISTANCE OF

WELL-KNOWN SPECIALISTS

With Illustrations

SIXTH EDITION, REVISED

TOTAL, SIX THOUSAND

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PREFACE TO SIXTH EDITION.

THE present edition of the Handbook has been carefully revised, with a view to including therein only the latest and best information on agricultural topics of importance to American farmers and dairymen. A number of new subjects have been added, and tables and articles have been brought up to date where better data were available. It is hoped that the changes and additions made will further increase the usefulness of this little volume to American farmers and students of agriculture.

F. W. WOLL.

June, 1914.

PREFACE TO FIRST EDITION.

THE effort of the author has been to make this small volume a compendium of useful information on farm and dairy topics. Brief discussions on subjects of importance and interest to farmers and dairymen have been introduced, and useful facts, tables, formulas, receipts, agricultural statistics, etc., are given to such an extent as the plan of the work permitted. Valuable data scattered throughout our agricultural literature, in the publications of our experiment stations and the scientific divisions of the United States Department of Agriculture, as well as in other public documents, and in farm papers and standard

works, have been gathered in this Handbook and arranged in such a manner as to make them easily accessible and convenient for reference purposes.

The present volume is founded on the Dairy and Agricultural Calendars previously published by the author. Much new material, both original and compiled, has, however, been included, and special articles, tables, statistics, etc., have been verified and brought up to date, making the book, as it is hoped, of considerable value, and securing for it as favorable a reception as was accorded its predecessors.

The author takes this opportunity of thanking the following specialists who have so materially increased the usefulness of the book by comprehensive, concise contributions on subjects in their particular lines of study: Professors W. H. Caldwell, J. A. Craig, John W. Decker, L. H. Dewey, F. H. Farrington, B. E. Fernow, E. S. Goff, A. W. Richter, H. L. Russell, Thos. Shaw, Wm. P. Wheeler; and Messrs. John Boyd, W. G. Clark, M.D.C., N. S. Fish, J. D. Frederiksen, H. B. Gurler, S. Hoxie, J. Noer, M.D., J. H. Pickrell, H. B. Richards, L. P. Sisson, J. McLain Smith, and C. M. Winslow.

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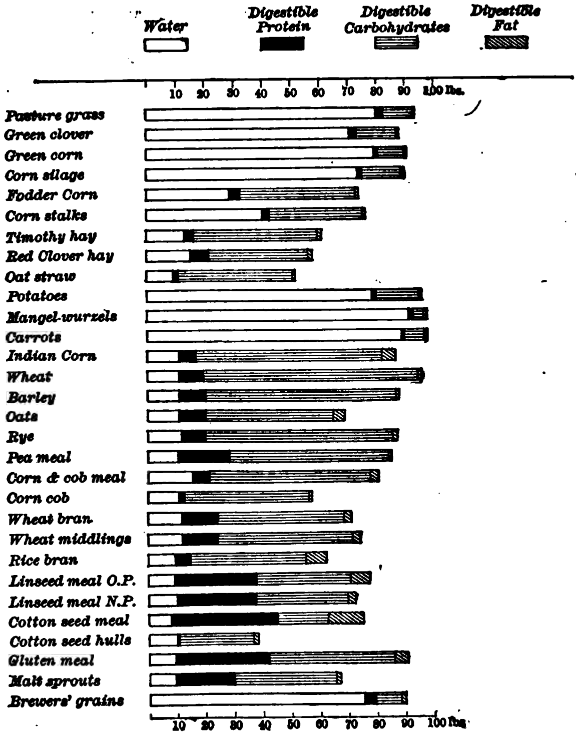
COMPOSITION OF FEEDING STUFFS.

Chart showing Pounds of Water and of Digestible Matter in 100 lbs.



PART I. AGRICULTURE.

I. FEEDING STUFFS.

COMPOSITION OF FEEDING STUFFS.

In the ordinary chemical analysis of feeding stuffs the following constituents are determined, viz., water, ash, protein, crude fiber, nitrogen-free extract, ether extract (fat).

Water is present in all feeding stuffs, from above 90 per cent in green foods and some kinds of roots, to below 10 per cent in very dry hay and in concentrated food stuffs.

Ash, or mineral matter, is the non-combustible part of plants, and goes to make the bones of the animal, or to supply material for the maintenance of other parts of the animal body.

Protein is the name of a large group of substances, all characterized by the fact that they contain the element nitrogen; hence they are also called *nitrogenous* substances, and foods rich in protein are spoken of as *nitrogenous foods*. The protein substances supply the material necessary for the formation of lean meat, ligaments, tendons, hair, horns, hoofs, etc., and also of casein of the milk. Crude protein includes *albuminoids* and *amides;* among the former are found white of egg, lean meat, curd of milk, and gluten; among the latter, asparagin and other crystallizable and water-soluble substances, generally speaking, of a somewhat inferior nutritive value.

Crude Fiber or woody fiber is the framework of plants, forming the walls of their cells; it is usually the least digestible portion of feeding stuffs, and the nutritive value of a plant is decreased as its crude fiber content increases.

Nitrogen-free Extract includes starch, sugar, gums, organic acids, etc., and forms a most important and usually a very large part of cattle foods. Together with cellulose, nitrogen-free extract forms the group of bodies called *carbo-*

hydrates. A general name for carbohydrates is *heat-producing substances*, as against *flesh-forming substances*, i.e., nitrogenous compounds, the names indicating the main offices of the substances in animal nutrition.

Ether Extract, or *crude fat* (*oil*) includes a group of compounds dissolved out by ether in the analysis of foods; fat forms the main part of the extract; most feeding stuffs contain only a small quantity of fat, but this component is nevertheless of considerable importance in the feeding of animals.

Organic Matter signifies the combustible portion of chemically dry feeding stuffs, i.e., all the components given in the preceding except water and ash.

Digestible Components.—The food stuffs used in the feeding of farm animals are only partly of direct value to the animals, the portion which their digestive fluids are unable to dissolve being voided in the excrements. The digestibility of fodders has been determined by direct experiments with different kinds of farm animals, in this country or abroad. The *digestion coefficients* (see pp. 6–8) mean the percentages of any one component which have been found to be digested by the animals experimented on.

Nutritive Ratio signifies the ratio between the digestible nitrogenous and non-nitrogenous components in a feeding stuff, or a combination of such. As fat has been found to yield about 2.2 times more heat, when burned, than do starch, sugar, and other carbohydrates, the per cent of digestible fat in a food is multiplied by 2.2 when the nutritive ratio is to be calculated; the product is added to the per cent of digestible carbohydrates (nitrogen-free extract + crude fiber), and this sum is divided by the per cent of digestible protein. (The factor $2\frac{1}{2}$ or $2\frac{1}{4}$ is sometimes used for obtaining "the starch equivalent" of fat.)

Example: Clover hay contains on the average 6.5 per cent digestible protein, 34.9 per cent digestible carbohydrates, and 1.6 per cent digestible fat (see following table):

$$1.6 \times 2.2 = 3.52; \quad 34.9 + 3.52 = 38.42; \quad 38.42 \div 6.5 = 5.9.$$

Nutritive ratio, 1 : 5.9.

AVERAGE COMPOSITION OF AMERICAN FEEDING STUFFS.

Feeding Stuffs.	No. of Analyses.	Percentage Composition.*							Per cent Digestible Matter.		
		Water.	Ash.	Crude Protein.	Crude Fiber.	Nitrogen-Free Extract.	Ether Extract.	Organic Matter.	Crude Protein	Carbohydrates.	Ether Extract.
Green Fodders and Silage.											
Pasture grass	...	80.0	2.0	3.5	4.0	9.7	.8	18.0	2.6	10.6	.5
Green fodder corn (maize)...............	126	79.3	1.2	1.8	5.0	12.2	.5	19.5	1.3	11.8	.4
Alfalfa (lucern)........	23	71.8	2.7	4.8	7.4	12.3	1.0	25.5	3.6	11.4	.4
Green clover.....	43	70.8	2.1	4.4	8.1	13.5	1.1	27.1	2.9	14.1	.7
Alsike clover, in bloom	4	74.8	2.0	3.9	7.4	11.0	.9	23.2	2.7	13.1	.6
Rye fodder	7	76.6	1.8	2.6	11.6	6.8	.6	21.6	2.1	14.1	.4
Oat fodder............	5	62.2	2.5	3.4	11.2	19.3	1.4	35.3	2.7	22.7	1.0
Sorghum fodder.......	11	79.4	1.1	1.3	6.1	11.6	.5	19.5	.8	12.7	.4
Red top, in bloom......	5	64.8	2.3	3.3	9.4	19.1	1.2	32.9	2.3	20.5	.7
Meadow fescue, in bloom...............	4	69.9	1.8	2.4	10.8	14.3	.8	28.3	1.7	17.8	.5
Timothy...............	56	61.6	2.1	3.1	11.8	20.2	1.2	36.3	2.2	23.0	.7
Blue-grass.............	81	65.1	2.8	4.1	9.1	17.6	1.3	32.1	2.9	19.2	.8
Prickly comfrey........	41	88.4	2.2	2.4	1.6	5.1	.3	9.4	1.4	4.6	.2
Corn silage	99	79.1	1.4	1.7	6.0	11.1	.8	19.5	.8	11.6	.7
Corn silage, Wis. anal.	17	73.6	2.1	2.7	7.8	12.9	.9	24.7	1.3	14.0	.7
Clover silage..........	5	72.0	2.6	4.2	8.4	11.6	1.2	25.4	2.0	13.5	1.0
Sorghum silage	6	76.1	1.1	.8	6.4	15.3	.3	22.8	.6	14.9	.2
Hay and Dry Coarse Fodders.											
Fodder corn (maize), field cured.	35	42.2	2.7	4.5	14.3	34.7	1.6	55.1	2.6	33.3	1.1
Same, Wis. analyses...	5	29.0	4.2	6.5	22.1	36.5	1.7	66.8	3.7	40.4	1.2
Corn stalks (stover), field cured.	60	40.1	3.4	3.8	19.7	31.9	1.1	56.5	2.0	33.4	.6
Hay from red clover.	38	15.3	6.2	12.3	24.8	38.1	3.3	78.5	6.5	34.9	1.6
Hay from mammoth clover..............	10	21.2	6.1	10.7	24.5	33.6	3.9	72.7	5.7	32.0	1.9
Hay f'm alfalfa (lucern)	21	8.4	7.4	14.3	25.0	42.7	2.2	84.2	10.3	41.4	1.2
Hay from alsike clover.	9	9.7	8.3	12.8	25.6	40.7	2.9	82.[illegible]	6.8	36.8	1.4
Oat hay..	6	8.9	6.2	7.6	29.3	45.1	2.9	84.9	4.1	46.4	1.5
Timothy hay...........	68	13.2	4.4	5.9	29.0	45.0	2.5	82.4	3.0	43.9	1.2
Hay from mixed meadow grasses..........	11	16.0	4.6	6.4	29.9	41.0	2.1	79.4	3.6	42.7	1.0
Hay from Hun. grass..	12	7.7	6.0	7.5	27.7	49.0	2.1	86.3	4.5	[illegible]	1.0
Flax hay	11	14.3	5.5	15.0	32.0	30.1	3.1	80.2	7.2	36.6	1.8
Crab-grass hay	2	10.3	7.3	6.9	32.9	41.0	1.6	82.4	2.2	42.8	.6
Marsh hay.............	2	7.9	5.2	7.8	30.1	46.3	2.7	86.9	3.5	44.7	1.7
Oat straw...	12	9.2	5.1	4.0	37.0	42.4	2.3	85.7	1.6	41.4	.7
Barley straw†	97	14.2	5.7	3.5	36.0	39.0	1.5	80.1	.9	41.3	.6
Wheat straw...........	7	9.6	4.2	3.4	38.1	43.4	1.3	86.2	.8	37.9	.5
Rye straw......	7	7.1	3.2	3.0	38.9	46.6	1.2	89.7	.8	42.7	.4
Buckwheat straw......	3	9.9	5.5	5.2	43.0	35.1	1.3	84.[illegible]	2.3	37.7	.6
Pea vine†	14	13.6	6.6	9.0	35.5	33.7	1.6	79.8	4.3	32.3	.8

* Largely from Jenkins and Winton's Compilation of Analyses of American Feeding Stuffs. † König.

AVERAGE COMPOSITION OF AMERICAN FEEDING STUFFS.—*Continued.*

Feeding Stuffs.	No. of Analyses.	Percentage Composition.							Per cent Digestible Matter.		
		Water.	Ash.	Crude Protein.	Crude Fiber.	Nitrogen-free Extract.	Ether Extract.	Organic Matter.	Crude Protein.	Carbohydrates.	Ether Extract.
Roots and Tubers.											
Potatoes	12	78.9	1.0	2.1	.6	17.3	.1	20.1	1.4	16.1	.1
Sweet potatoes	6	71.1	1.0	1.5	1.3	24.7	.4	27.9	.9	22.2	.3
Red beets	9	88.5	1.0	1.5	.9	8.0	.1	10.5	.9	7.6	.1
Sugar beets	19	86.5	.9	1.8	.9	9.8	.1	12.6	1.1	9.3	.1
Mangel-wurzels	9	90.9	1.1	1.4	.9	5.5	.2	8.0	1.1	4.8	.2
Rutabagas	4	88.6	1.2	1.2	1.3	7.5	.2	10.2	.9	7.1	.2
Turnips	3	90.5	.8	1.1	1.2	6.2	.2	8.7	.6	5.5	.2
Carrots	8	88.6	1.0	1.1	1.3	7.6	.4	10.4	1.0	7.1	.3
Artichoke	2	79.5	1.0	2.6	.8	15.9	.2	19.5	2.0	16.8	.2
Grains and Flour Mill Products.											
Corn (maize)	208	10.9	1.5	10.5	2.1	69.6	5.4	87.6	7.1	64.8	5.0
Corn and cob meal	7	15.1	1.5	8.5	6.6	64.8	3.5	83.4	5.8	56.3	2.9
Corn cob	18	10.7	1.4	2.4	30.1	54.9	.5	87.9	1.6	43.9	.3
Corn bran (hulls)	5	9.1	1.3	9.0	12.7	62.2	5.8	89.6	5.0	59.8	4.6
Oats	30	11.0	3.0	11.8	9.5	59.7	5.0	86.0	9.1	44.7	4.1
Oat shorts *	6	10.0	5.2	16.2	7.5	54.5	6.6	84.8	12.6	45.7	5.4
Oat feed	4	7.7	3.7	16.0	6.1	59.4	7.1	88.6	12.5	46.9	2.8
Oat hulls	1	7.3	6.7	3.3	29.7	52.1	1.0	86.0	1.3	40.1	.6
Oat dust	2	6.5	6.9	13.5	18.2	50.2	4.8	86.6	8.9	38.4	5.1
Barley	10	10.9	2.4	12.4	2.7	69.8	1.8	86.7	9.5	66.1	1.2
Barley screenings	2	12.2	3.6	12.3	7.3	61.8	2.8	84.2	9.3	57.3	1.8
Wheat	310	10.5	1.8	11.9	1.8	71.9	2.1	87.7	9.2	64.9	1.4
Wheat bran—roller process	7	12.0	5.6	16.1	8.4	53.7	4.2	82.4	12.6	44.1	2.9
Wheat bran-old process	9	12.0	4.9	13.0	8.1	58.2	3.8	83.1	10.1	47.5	2.6
Wheat shorts	12	11.8	4.6	14.9	7.4	56.8	4.5	83.6	11.6	45.4	3.2
Wheat middlings	33	12.1	3.4	15.7	4.7	60.2	4.0	84.5	12.2	47.2	2.9
Wheat screenings	10	11.6	2.9	12.5	4.9	65.1	3.0	85.5	9.8	51.0	2.2
Low-grade flour ("red dog")	8	10.0	2.2	15.8	1.6	67.7	2.7	87.8	13.5	61.3	2.0
Rye	6	11.6	1.0	10.6	1.7	72.5	1.7	86.5	8.3	65.5	1.2
Rye bran	7	11.6	3.6	14.7	3.5	63.8	2.8	84.8	9.7	48.0	1.6
Rye shorts	1	9.3	5.9	18.0	5.1	59.9	2.8	85.8	11.9	45.1	1.6
Buckwheat	8	12.6	2.0	10.0	8.7	64.5	2.2	85.4	7.7	49.2	1.8
Buckwheat bran	2	10.5	3.0	12.4	31.9	38.8	3.3	86.5	7.4	30.4	1.9
Buckwheat shorts	2	11.1	5.1	27.1	8.3	40.8	7.0	83.8	21.1	33.5	5.5
Buckwheat middlings	6	12.7	5.1	28.2	4.2	42.3	7.5	82.2	22.0	33.4	5.4
Rice	10	12.4	.4	7.4	.2	79.2	.4	87.2	4.8	72.2	.3
Rice bran	5	9.7	10.0	12.1	9.5	49.9	8.8	80.3	5.3	45.1	7.3
Rice hulls	3	8.2	13.2	3.6	35.7	38.6	.7	78.6	1.6	44.5	.6
Rice polish	4	10.0	6.7	11.7	6.3	58.0	7.3	83.3	9.0	56.4	6.5
Pea meal	2	10.5	2.6	20.2	14.4	51.1	1.2	86.9	18.0	56.0	.9

* König.

AVERAGE COMPOSITION OF AMERICAN FEEDING STUFFS—(*Continued*).

Feeding Stuffs.	No. of Analyses.	Percentage Composition.							Per cent Digestible Matter.		
		Water.	Ash.	Crude Protein.	Crude Fiber.	Nitrogen-free Extract.	Ether Extract.	Organic Matter.	Crude Protein.	Carbohydrates.	Ether Extract.
Sorghum seed.	10	12.8	2.1	9.1	2.6	69.8	3.6	85.1	7.0	52.1	3.1
Broom corn.	2	11.5	3.4	10.2	7.1	64.6	3.0	85.1	7.4	48.3	2.9
Flaxseed.	50	9.2	4.3	22.6	7.1	23.2	33.7	86.5	20.6	17.1	29.0
Cow pea.	5	14.8	3.2	20.8	4.1	55.7	1.4	82.0	18.3	54.2	1.1
Soja bean.	8	10.8	4.7	34.0	4.8	28.8	16.9	84.5	29.6	17.0	15.9
Miscellaneous Feeds.											
Malt sprouts.	5	9.6	5.9	24.8	11.0	47.0	1.7	84.5	10.8	36.2	1.7
Brewers' grains, wet.	15	75.7	1.0	5.4	3.8	12.5	1.6	23.3	3.9	9.5	1.3
Brewers' grains, dried.	5	7.7	3.6	22.2	12.3	47.9	6.3	88.7	16.2	35.5	5.3
Hominy chops (meal).	14	10.0	2.5	9.9	3.7	64.4	8.5	86.6	8.0	61.0	7.8
Gluten feed.	7	8.3	.9	21.6	6.8	49.6	12.7	90.8	18.6	48.3	11.1
Cream gluten meal.	5	8.2	1.3	32.8	1.7	42.0	14.1	90.5	29.5	39.6	12.8
Chicago gluten meal.	3	9.5	.9	35.8	1.5	46.8	5.6	89.6	32.2	44.1	5.1
Corn oil cake.	3	9.0	2.4	24.8	6.7	43.6	13.5	88.6	22.3	42.6	12.3
Germ meal (corn germ)	4	10.4	3.6	10.0	5.0	64.2	6.8	86.0	9.0	61.2	6.2
Grano-gluten.	3	5.7	2.7	31.0	11.4	34.8	14.2	91.6	26.7	38.8	12.4
Starch feed, wet.	12	65.4	.3	6.1	3.1	22.0	3.1	34.3	5.5	21.7	2.3
Cotton-seed meal	37	8.2	7.2	42.4	5.6	23.8	12.9	84.6	36.9	18.1	12.3
Cotton-seed hulls	10	9.9	2.9	4.2	47.4	33.2	2.2	87.2	1.0	26.2	1.8
Linseed meal, old process.	21	9.2	5.7	32.9	8.9	35.4	7.9	85.1	28.3	32.8	7.1
Linseed meal, new process.	14	10.1	5.8	33.2	9.5	38.5	3.0	84.1	27.2	32.9	2.7
Palm-nut meal *	600	10.4	4.3	16.8	24.0	35.0	9.5	85.3	16.0	52.6	9.0
Sugar-beet leaves.	...	88.0	2.4	2.6	2.2	4.4	.4	9.6	1.7	4.6	.2
Prickly comfrey	41	88.4	2.2	2.4	1.6	5.1	.3	9.4	1.4	4.6	.2
Rape.	2	84.5	2.0	2.3	2.6	8.4	.5	13.5	1.5	8.1	.2
Pumpkins.	...	90.9	.5	1.3	1.7	5.2	.4	8.6	1.0	5.8	.3
Apples *	36	84.8	.5	.4	1.5	12.5	.3	14.7	.3	12.8	.2
Apple pomace.	7	76.7	.5	1.4	3.9	16.2	1.3	22.8	1.0	11.9	1.1
Beet molasses.	35	20.8	10.6	9.1	....	59.5	....	68.6	9.1	59.5	..
Beet pulp.	16	89.8	.6	.9	2.4	6.3	....	9.6	.6	7.3	....
Dried beet pulp	1	4.4	4.1	8.3	19.0	63.5	.7	91.5	5.8	67.7	.6
Molasses beet pulp	1	3.7	4.5	9.8	18.6	62.7	.7	91.8	6.6	67.0	.6
Meat-scraps *	144	10.7	4.1	71.2	....	.3	13.7	85.2	68.4	.3	13.5
Dried blood *	3	8.5	4.7	84.4	....	....	2.5	86.8	58.1	....	2.3
Skimmed milk *	96	90.4	.7	3.3	....	4.7	.8	8.9	3.1	4.7	.8
Buttermilk *	85	90.1	.7	4.0	....	4.0	1.1	9.2	3.9	4.0	1.1
Whey *	46	93.4	.7	.9	...	4.8	.3	5.9	.8	4.7	.3

* König.

READY REFERENCE TABLE OF COMPOSITION OF FEEDS. (Hills.)

The following tables save calculations of percentages, since, the weights and contents being given in pounds, it is only necessary to find the kind and desired amount of a certain feed, and the tables give the exact food contents in pounds; e.g., 15 lbs. of Green Fodder Corn contain 3.1 lbs. of dry matter, 0.17 lbs. of digestible protein, and 1.9 lbs. digestible carbohydrates and fat.

Pounds of Feed.	Total Dry Matter.	Protein.	Carbohydrates and Fat.	Total Dry Matter.	Protein.	Carbohydrates and Fat.	Total Dry Matter.	Protein.	Carbohydrates and Fat.
Green Fodders.	Pasture Grass 1 : 4.8			Timothy Grass 1 : 14.3			Ky. Blue Grass, 1 : 9.2		
2½	0.5	0.06	0.3	1.0	0.04	0.5	0.9	0.05	0.5
5	1.0	0.12	0.6	1.9	0.08	1.1	1.8	0.10	0.9
10	2.0	0.23	1.1	3.8	0.15	2.1	3.5	0.20	1.8
15	3.0	0.35	1.7	5.8	0.23	3.2	5.2	0.30	2.7
20	4.0	0.46	2.2	7.7	0.30	4.3	7.0	0.40	3.7
25	5.0	0.58	2.8	9.6	0.38	5.4	8.7	0.50	4.7
30	6.0	0.69	3.3	11.5	0.45	6.4	10.5	0.60	5.5
35	7.0	0.81	3.9	13.4	0.53	7.5	12.2	0.70	6.4
40	8.0	0.92	4.4	15.4	0.60	8.6	14.0	0.80	7.3
	Green Fodder Corn, 1 : 11.7			Green Oat Fodder, 1 : 8.7			Green Rye Fodder, 1 : 7.2		
2½	0.5	0.03	0.3	0.9	0.06	0.5	0.6	0.05	0.4
5	1.0	0.06	0.6	1.9	0.12	1.0	1.2	0.11	0.7
10	2.1	0.11	1.3	3.8	0.24	2.1	2.3	0.21	1.5
15	3.1	0.17	1.9	5.7	0.36	3.1	3.5	0.32	2.3
20	4.1	0.22	2.6	7.6	0.48	4.2	4.7	0.42	3.0
25	5.2	0.28	3.2	9.5	0.60	5.2	5.9	0.52	3.8
30	6.2	0.33	3.9	11.3	0.72	6.2	7.0	0.63	4.5
35	7.2	0.39	4.5	13.2	0.84	7.3	8.2	0.74	5.3
40	8.3	0.44	5.2	15.1	0.96	8.3	9.4	0.84	6.0
	Oats and Peas, 1 : 4.2			Barley and Peas, 1 : 3.2			Red Clover (green) 1 : 5.7		
2½	0.5	0.07	0.3	0.5	0.07	0.2	0.7	0.07	0.4
5	1.1	0.14	0.5	1.0	0.14	0.4	1.5	0.15	0.8
10	2.1	0.27	1.1	2.1	0.28	0.9	2.9	0.29	1.6
15	3.2	0.41	1.7	3.1	0.42	1.4	4.4	0.44	2.5
20	4.3	0.54	2.3	4.1	0.56	1.8	5.9	0.58	3.3
25	5.3	0.68	2.9	5.2	0.70	2.3	7.3	0.73	4.1
30	6.4	0.81	3.4	6.2	0.84	2.7	8.8	0.87	4.9
35	7.5	0.95	4.0	7.2	0.98	3.2	10.2	1.02	5.7
40	8.5	1.08	4.6	8.2	1.12	3.6	11.7	1.16	6.6
	Corn Silage, 1 : 14.8			Corn Stover Silage, 1 : 16.6			Clover Silage, 1 : 4.7		
2½	0.7	0.03	0.4	0.5	0.02	0.3	0.7	0.07	0.3
5	1.3	0.06	0.8	1.0	0.03	0.5	1.4	0.14	0.6
10	2.6	0.12	1.8	1.9	0.06	1.0	2.8	0.27	1.3
15	3.9	0.18	2.7	2.9	0.09	1.5	4.2	0.41	1.9
20	5.3	0.24	3.6	3.9	0.12	2.0	5.6	0.54	2.6
25	6.6	0.30	4.5	4.8	0.15	2.5	7.0	0.68	3.2
30	7.9	0.36	5.3	5.8	0.18	3.0	8.4	0.81	3.9
35	9.2	0.42	6.2	6.8	0.21	3.5	9.8	0.95	4.5
40	10.5	0.48	7.1	7.7	0.24	4.0	11.2	1.08	5.1

COMPOSITION OF FEEDS—(*Continued*).

Pounds of Feed.	Total Dry Matter.	Protein.	Carbohydrates and Fat.	Total Dry Matter.	Protein.	Carbohydrates and Fat.	Total Dry Matter.	Protein.	Carbohydrates and Fat.
Roots.	Potatoes, 1 : 17.3			Sugar Beets, 1 : 6.8			Carrots, 1 : 9.6		
2½	0.5	0.02	0.4	0.3	0.04	0.3	0.3	0.03	0.2
5	1.1	0.05	0.8	0.7	0.08	0.5	0.5	0.05	0.5
10	2.1	0.09	1.6	1.4	0.16	1.1	1.1	0.10	1.0
15	3.2	0.14	2.3	2.0	0.24	1.7	1.6	0.15	1.4
20	4.2	0.18	3.1	2.7	0.32	2.2	2.3	0.20	1.9
25	5.3	0.23	3.9	3.4	0.40	2.7	2.9	0.25	2.4
30	6.3	0.27	4.7	4.1	0.48	3.3	3.4	0.30	2.9
35	7.4	0.32	5.4	4.7	0.56	3.8	4.0	0.35	3.4
40	8.4	0.36	6.2	5.4	0.64	4.4	4.6	0.40	3.8
	Mangel Wurtzels, 1 : 4.9			Rutabagas, 1 : 8.6			Turnips, 1 : 7.7		
2½	0.2	0.03	0.1	0.3	0.03	0.2	0.2	0.05	0.2
5	0.4	0.06	0.3	0.5	0.05	0.4	0.5	0.05	0.4
10	0.9	0.11	0.5	1.1	0.10	0.9	1.0	0.10	0.8
15	1.4	0.17	0.8	1.6	0.15	1.3	1.4	0.15	1.2
20	1.8	0.22	1.1	2.3	0.20	1.7	1.9	0.20	1.5
25	2.3	0.28	1.4	2.9	0.25	2.2	2.4	0.25	1.9
30	2.7	0.33	1.6	3.4	0.30	2.6	2.9	0.30	2.3
35	3.2	0.39	1.9	4.0	0.35	3.0	3.3	0.35	2.7
40	3.6	0.44	2.2	4.6	0.40	3.4	3.8	0.40	3.1
Milk.	Skim Milk, 1 : 2.0			Buttermilk, 1: 1.7			Whey, 1 : 8.7		
2½	0.2	0.07	0.1	0.2	0.10	0.2	0.2	0.02	0.1
5	0.5	0.15	0.3	0.5	0.19	0.3	0.3	0.03	0.3
10	0.9	0.29	0.6	1.0	0.38	0.6	0.6	0.06	0.5
15	1.4	0.44	0.9	1.5	0.57	1.0	0.9	0.09	0.8
20	1.9	0.58	1.2	2.0	0.76	1.3	1.2	0.12	1.0
25	2.4	0.73	1.6	2.5	0.95	1.6	1.5	0.15	1.3
30	2.8	0.87	1.8	3.0	1.14	1.9	1.9	0.18	1.6
35	3.2	1.02	2.1	3.5	1.33	2.2	2.2	0.21	1.8
40	3.7	1.16	2.4	4.0	1.52	2.6	2.5	0.24	2.1
Hays.	Mixed Hay, 1 : 10.0			Timothy Hay, 1 : 16.5			Ky. Blue Grass Hay, 1 : 10.6		
2½	2.1	0.11	1.1	2.2	0.07	1.2	1.9	0.09	1.0
5	4.2	0.22	2.2	4.3	0.14	2.3	3.7	0.19	2.0
7½	6.4	0.33	3.3	6.5	0.21	3.5	5.6	0.28	3.0
10	8.5	0.44	4.4	8.7	0.28	4.6	7.4	0.37	3.9
12½	10.6	0.55	5.5	10.9	0.35	5.8	9.2	0.46	4.9
15	12.7	0.66	6.6	13.0	0.42	6.9	11.1	0.56	5.9
17½	14.8	0.77	7.7	15.2	0.49	8.1	13.0	0.65	6.9
20	16.9	0.88	8.8	17.4	0.56	9.2	14.8	0.74	7.9
25	21.2	1.10	11.0	21.7	0.70	11.6	18.5	0.93	9.9

COMPOSITION OF FEEDS—(*Continued*).

Pounds of Feed.	Total Dry Matter.	Protein.	Carbohydrates and Fat.	Total Dry Matter.	Protein.	Carbohydrates and Fat.	Total Dry Matter.	Protein.	Carbohydrates and Fat.
Hays.	Oat Hay, 1 : 9.9			Oat and Pea Hay, 1 : 4.1			Hungarian, 1 : 10.0		
2½	2.3	0.10	1.0	2.2	0.28	1.2	2.1	0.12	1.2
5	4.6	0.21	2.0	4.4	0.56	2.3	4.2	0.25	2.4
7½	6.8	0.31	3.0	6.6	0.84	3.5	6.3	0.37	3.6
10	9.1	0.41	4.0	8.9	1.12	4.6	8.4	0.49	4.9
12½	11.4	0.51	5.1	11.1	1.40	5.8	10.4	0.62	6.2
15	13.7	0.62	6.1	13.3	1.68	6.9	12.5	0.74	7.4
17½	16.0	0.72	7.1	15.5	1.96	8.1	14.6	0.86	8.6
20	18.2	0.82	8.1	17.7	2.24	9.2	16.7	0.98	9.8
25	22.8	1.03	10.2	22.1	2.80	11.6	20.9	1.23	12.3
	Red Clover Hay, 1 : 5.9			Alsike Clover Hay, 1 : 5.5			Oat Straw, 1 : 38.3		
2½	2.1	0.18	1.0	2.3	0.21	1.2	2.3	0.03	1.2
5	4.2	0.36	2.1	4.5	0.42	2.3	4.6	0.06	2.3
7½	6.4	0.53	3.2	6.8	0.63	3.5	6.8	0.09	3.5
10	8.5	0.71	4.2	9.0	0.84	4.6	9.1	0.12	4.6
12½	10.6	0.89	5.2	11.3	1.05	5.8	11.4	0.15	5.8
15	12.7	1.07	6.3	13.5	1.26	6.9	13.9	0.18	6.9
17½	14.8	1.24	7.3	15.8	1.47	8.1	16.0	0.21	8.1
20	16.9	1.42	8.3	18.1	1.68	9.2	18.2	0.24	9.2
25	21.2	1.78	10.5	22.6	2.10	11.6	22.7	0.30	11.5
Dry Fodders.	Corn Fodder, 1 : 14.3			Corn Stover, 1 : 23.6			Wheat Straw, 1 : 93.0		
2½	1.4	0.06	0.9	1.5	0.04	0.8	2.3	0.01	0.9
5	2.9	0.13	1.8	3.0	0.07	1.7	4.5	0.02	1.9
7½	4.3	0.19	2.7	4.5	0.11	2.5	6.8	0.03	2.8
10	5.8	0.25	3.6	6.0	0.14	3.3	9.0	0.04	3.7
12½	7.2	0.32	4.5	7.5	0.18	4.1	11.3	0.05	4.6
15	8.7	0.38	5.4	9.0	0.21	5.0	13.5	0.06	5.6
17½	10.1	0.44	6.2	10.5	0.25	5.8	15.8	0.07	6.5
20	11.6	0.50	7.1	12.0	0.28	6.6	18.1	0.08	7.4
25	14.5	0.63	8.9	15.0	0.35	8.3	22.6	0.10	9.3
Grains.	Corn Meal, 1 : 11.3			Corn and Cob Meal, 1 : 13.9			Oats, 1 : 6.2		
¼	0.2	0.02	0.2	0.2	0.01	0.2	0.2	0.02	0.1
½	0.4	0.03	0.4	0.4	0.02	0.3	0.4	0.05	0.3
1	0.9	0.06	0.7	0.9	0.05	0.7	0.9	0.09	0.6
2	1.7	0.13	1.4	1.7	0.10	1.3	1.8	0.18	1.1
3	2.6	0.19	2.1	2.6	0.14	2.0	2.7	0.28	1.7
4	3.4	0.25	2.9	3.4	0.19	2.7	3.6	0.37	2.3
5	4.3	0.32	3.6	4.3	0.24	3.4	4.5	0.46	2.8
7½	6.4	0.48	5.4	6.4	0.36	5.1	6.7	0.69	4.3
10	8.5	0.63	7.1	8.5	0.48	6.7	8.9	0.92	5.7

COMPOSITION OF FEEDS—(*Continued*).

Pounds of Feed.	Total Dry Matter.	Protein.	Carbohydrates and Fat.	Total Dry Matter.	Protein.	Carbohydrates and Fat.	Total Dry Matter.	Protein.	Carbohydrates and Fat.
By-products.	Barley, 1 : 8.0			Barley Screenings, 1 : 7.7			Wheat Bran, 1 : [illegible]		
¼	0.2	0.02	0.2	0.2	0.02	0.2	0.2	0.03	0.1
½	0.4	0.04	0.3	0.4	0.04	0.3	0.4	0.06	0.2
1	0.9	0.09	0.7	0.9	0.09	0.7	0.9	0.12	0.5
2	1.8	0.17	1.4	1.8	0.17	1.3	1.8	0.24	1.0
3	2.7	0.26	2.1	2.6	0.26	2.0	2.6	0.36	1.4
4	3.6	0.35	2.8	3.5	0.34	2.7	3.5	0.48	1.8
5	4.5	0.44	3.5	4.4	0.43	3.3	4.4	0.60	2.3
7½	6.7	0.65	5.2	6.6	0.65	5.0	6.6	0.90	3.4
10	8.9	0.87	6.9	8.8	0.86	6.6	8.8	1.20	4.6
	Wheat Middlings, 1 : 4.6			Wheat Screenings, 1 : 5.2			Red-dog Flour, 1 : 3.3		
¼	0.2	0.03	0.1	0.2	0.02	0.1	0.2	0.04	0.1
½	0.4	0.06	0.3	0.4	0.05	0.2	0.5	0.09	0.3
1	0.9	0.13	0.6	0.9	0.10	0.5	0.9	0.18	0.6
2	1.8	0.25	1.2	1.8	0.20	1.0	1.8	0.36	1.2
3	2.6	0.38	1.7	2.7	0.29	1.5	2.7	0.53	1.7
4	3.5	0.50	2.3	3.5	0.39	2.0	3.6	0.71	2.3
5	4.4	0.63	2.9	4.4	0.49	2.5	4.6	0.89	2.9
7½	6.6	0.94	4.4	6.6	0.74	3.8	6.8	1.34	4.4
10	8.8	1.25	5.8	8.8	0.98	5.1	9.1	1.78	5.8
	Rye, 1 : 7.8			Rye Bran, 1 : 5.1			Cottonseed Meal, 1 : 1.0		
¼	0.2	0.02	0.2	0.2	0.03	0.2	0.2	0.10	0.1
½	0.4	0.04	0.3	0.4	0.06	0.3	0.5	0.20	0.2
1	0.9	0.09	0.7	0.9	0.12	0.6	0.9	0.40	0.4
2	1.8	0.18	1.4	1.8	0.25	1.3	1.8	0.80	0.8
3	2.7	0.27	2.1	2.7	0.37	1.9	2.8	1.20	1.2
4	3.5	0.36	2.8	3.5	0.49	2.5	3.7	1.60	1.6
5	4.4	0.46	3.5	4.4	0.62	3.1	4.6	2.00	2.0
7½	6.6	0.67	5.2	6.6	0.92	4.7	6.9	3.00	3.0
10	8.8	0.89	6.9	8.8	1.23	6.3	9.2	4.00	4.0
	Cottonseed Hulls,			Linseed Meal, o.p. 1 : 1.5			Linseed Meal, n.p. 1 : 1.3		
¼	0.2	.....	0.1	0.2	0.08	0.1	0.2	0.08	0.1
½	0.4	.....	0.2	0.5	0.15	0.2	0.4	0.16	0.2
1	0.9	.....	0.4	0.9	0.31	0.5	0.9	0.32	0.4
2	1.8	.....	0.7	1.8	0.62	1.0	1.8	0.65	0.8
3	2.7	.....	1.1	2.7	0.92	1.4	2.7	0.97	1.3
4	3.6	.....	1.5	3.6	1.23	1.8	3.6	1.30	1.7
5	4.5	.....	1.8	4.9	1.54	2.3	4.5	1.62	2.1
7½	6.7	.....	2.7	6.8	2.31	3.4	6.7	2.43	3.2
10	8.9	.....	3.7	9.0	3.08	4.6	8.9	3.24	4.2

COMPOSITION OF FEEDS—(*Continued*).

Pounds of Feed.	Total Dry Matter.	Protein.	Carbohydrates and Fat.	Total Dry Matter.	Protein.	Carbohydrates and Fat.	Total Dry Matter.	Protein.	Carbohydrates and Fat.
By-products.	Flax Meal, 1 : 1.4			Gluten Meal (Chi.), 1 : 1.5			Gluten Meal, Cream, 1 : 1.7		
¼	0.2	0.08	0.1	0.2	0.08	0.1	0.2	0.07	0.1
½	0.4	0.16	0.2	0.4	0.16	0.2	0.4	0.15	0.2
1	0.9	0.32	0.4	0.9	0.32	0.5	0.9	0.30	0.5
2	1.8	0.64	0.9	1.8	0.64	0.9	1.8	0.59	1.0
3	2.7	0.96	1.3	2.6	0.96	1.4	2.7	0.89	1.5
4	3.6	1.28	1.7	3.5	1.28	1.9	3.6	1.19	2.1
5	4.5	1.60	2.2	4.4	1.60	2.3	4.5	1.49	2.6
7½	6.7	2.40	3.3	6.6	2.40	3.5	6.7	2.23	3.9
10	8.9	3.21	4.3	8.8	3.21	4.7	9.0	2.97	5.1
	Gluten Feed, Buffalo, 1 : 2.4			Hominy Chop, 1 : 9.2			Dried Brewers' Grains, 1 : 3.0		
¼	0.2	0.06	0.1	0.2	0.02	0.2	0.2	0.04	0.1
½	0.4	0.12	0.3	0.5	0.04	0.4	0.5	0.08	0.3
1	0.9	0.23	0.6	0.9	0.09	0.8	0.9	0.16	0.5
2	1.8	0.47	1.1	1.8	0.17	1.6	1.8	0.31	0.9
3	2.7	0.70	1.7	2.8	0.26	2.4	2.8	0.47	1.4
4	3.6	0.93	2.3	3.7	0.35	3.2	3.7	0.63	1.9
5	4.5	1.17	2.8	4.6	0.44	4.0	4.6	0.79	2.4
7½	6.8	1.75	4.3	6.9	0.65	6.0	6.9	1.18	3.5
10	9.0	2.33	5.7	9.2	0.87	8.0	9.2	1.57	4.7
	Atlas Gluten Meal, 1 : 2.6			Malt Sprouts, 1 : 2.2			Pea Meal 1 : 3.2		
¼	0.2	0.06	0.2	0.2	0.05	0.1	0.2	0.04	0.1
½	0.5	0.12	0.3	0.4	0.09	0.2	0.4	0.08	0.3
1	0.9	0.25	0.6	0.9	0.19	0.4	0.9	0.17	0.5
2	1.8	0.49	1.3	1.8	0.37	0.8	1.8	0.33	1.1
3	2.8	0.74	1.9	2.7	0.56	1.2	2.7	0.50	1.6
4	3.7	0.98	2.6	3.6	0.74	1.6	3.6	0.67	2.1
5	4.6	1.23	3.2	4.5	0.93	2.0	4.5	0.84	2.7
7½	6.9	1.85	4.9	6.7	1.40	3.0	6.7	1.26	4.0
10	9.2	2.46	6.5	9.0	1.86	4.0	9.0	1.68	5.3

CLASSIFICATION OF CATTLE FOODS. (LINDSEY.)

A. Coarse Feeds (Roughage).

I. Low in protein, high in carbohydrates:

(*a*) 50–65 per cent. digestible: Hays, straws, corn fodder, corn stover, and silage.

(*b*) 85–95 per cent. digestible: Carrots, potatoes, sugar beets, mangels, turnips.

II. Medium in protein and in carbohydrates, 55–65 per cent. digestible: Clovers, vetches, pea and bean fodders and brans.

B. Concentrated Feeds (Concentrates).

III. Low in protein, high in carbohydrates, 80–90 per cent. digestible: Wheat, rye, barley, oats, Indian corn.

IV. High in protein, medium in carbohydrates, 80–90 per cent. digestible: Bean and pea meals, gluten feeds and meals, linseed meals, cottonseed meal.

CLASSIFICATION OF CONCENTRATES, ACCORDING TO PROTEIN CONTENT:

(*a*) *Very rich in protein* (about 80 per cent.): Dried blood, meat scraps, cottonseed meal.

(*b*) *Rich in protein* (25–40 per cent.): Gluten meal, Atlas meal, linseed meal, buckwheat middlings, soja beans, grano-gluten.

(*c*) *Fairly rich in protein* (12–25 per cent.) Malt sprouts, dried brewers' grains, gluten feed, cow pea, pea meal, wheat shorts, rye shorts, oat shorts, wheat middlings, wheat bran, low-grade flour (red-dog).

(*d*) *Low in protein* (below 12 per cent.): Wheat, barley, oats, rye, corn, rice polish, rice, hominy chops, germ meal.

FEEDING STANDARDS FOR FARM ANIMALS.

(Wolff-Lehmann.)

(Per day and per 1000 lbs. live weight.)

	Total Dry Substance.	Nutritive (Digestible) Substances. Crude Protein.	Carbo-hydrates.	Ether Extract.	Total Nutritive Substances.	Nutritive Ratio.
	lbs.	lbs.	lbs.	lbs.	lbs.	
1. Steers at rest in stall....	18	0.7	8.0	0.1	8.9	1:11.8
Steers slightly worked....	22	1.4	10.0	0.3	12.1	1: 7.7
Steers moderately worked..........	25	2.0	11.5	0.5	14.7	1: 6.5
Steers heavily worked.......	28	2.8	13.0	0.8	17.7	1: 5.3
2. Fattening steers, 1st period.........	30	2.5	15.0	0.5	18.7	1: 6.5
" " 2d "	30	3.0	14.5	0.7	19.2	1: 5.4
" " 3d "	26	2.7	15.0	0.7	19.4	1: 6.2
3. Milch cows, daily milk yield, 11 lbs.	25	1.6	10.0	0.3	12.3	1: 6.7
" " " " " 16.5 "	27	2.0	11.0	0.4	14.0	1: 6.0
" " " " " 22 "	29	2.5	13.0	0.5	16.7	1: 5.7
" " " " " 27.6 "	32	3.3	13.0	0.8	18.2	1: 4.5
4. Wool sheep, coarser breeds........	20	1.2	10.5	0.2	12.2	1: 9.1
" " finer breeds...........	23	1.5	12.0	0.3	14.2	1: 8.5
5. Breeding ewes, with lambs..... ...	25	2.9	15.0	0.5	19.1	1: 5.6
6. Fattening sheep, 1st period........	30	3.0	15.0	0.5	19.2	1: 5.4
" " 2d "	28	3.5	14.5	0.6	19.4	1: 4.5
7. Horses lightly worked.......... ...	20	1.5	9.5	0.4	12.0	1: 7.0
Horses moderately worked.........	24	2.0	11.0	0.6	14.5	1: 6.2
Horses heavily worked.............	26	2.5	13.3	0.8	17.7	1: 6.0
8. Brood sows, with pigs.	22	2.5	15.5	0.4	19.0	1: 6.6
9. Fattening swine, 1st period.... ..	36	4.5	25.0	0.7	31.2	1: 5.9
" " 2d "	32	4.0	24.0	0.5	29.2	1: 6.3
" " 3d "	25	2.7	18.0	0.4	22.0	1: 7.0
10. Growing cattle:						
Dairy Breeds.						
Age, Months. — *Aver. live weight per head.*						
2-3 — 154 lbs.......	23	4.0	13.0	2.0	21.8	1: 4.5
3-6 — 309 "	24	3.0	12.8	1.0	18.2	1: 5.1
6-12 — 507 "	27	2.0	12.5	0.5	15.7	1: 6.8
12-18 — 705 "	26	1.8	12.5	0.4	15.3	1: 7.5
18-24 — 882 "	26	1.5	12.0	0.3	14.2	1: 8.5

FEEDING STANDARDS FOR FARM ANIMALS.

(*Concluded.*)

		Total Dry Substance.	Nutritive (Digestible) Substances. Crude Protein.	Carbo-hydrates.	Ether Extract.	Total Nutritive Substances.	Nutritive Ratio.
		lbs.	lbs.	lbs.	lbs.	lbs.	
11. Growing cattle:							
Beef Breeds.							
Age, Months.	*Aver. live weight per head.*						
2–3	165 lbs.......	23	4.2	13.0	2.0	20.0	1:4.2
3–6	331 "	24	3.5	12 8	1.5	19.9	1:4.7
6–12	551 "	25	2.5	13.2	0.7	17.4	1:6.0
12–18	750 "	24	2.0	12.5	0.5	15.7	1:6.8
18–24	937 "	24	1.8	12.0	0.4	14.8	1:7.2
12. Growing sheep:							
Wool Breeds.							
4–6	62 lbs.......	25	3.4	15.4	0.7	20.5	1:5.0
6–8	75 "	25	2.8	13.8	0.6	18.0	1:5.4
8–11	84 "	23	2.1	11.5	0.5	14.8	1:6.0
11–15	90 "	22	1.8	11.2	0.4	14.0	1:7.0
15–20	99 "	22	1.5	10.8	0.3	13.0	1:7.7
13. Growing sheep:							
Mutton Breeds.							
4–6	66 lbs.......	26	4.4	15.5	0.9	22.1	1:4.0
6–8	84 "	26	3.5	15.0	0.7	20.2	1:4.8
8–11	101 "	24	3.0	14.3	0.5	18.5	1:5.2
11–15	121 "	23	2.2	12.6	0.5	16.0	1:6.3
15–20	154 "	22	2.0	12.0	0.4	15.0	1:6.5
14. Growing swine:							
Breeding Animals.							
2–3	44 lbs.......	44	7.6	28.0	1.0	38.0	1:4.0
3–5	99 "	35	5.0	23.1	0.8	30.0	1:5.0
5–6	121 "	32	3.7	21.3	0.4	26.0	1:6.0
6–8	176 "	28	2.8	18.7	0.3	22.2	1:7.0
8–12	265 "	25	2.1	15.3	0.2	17.9	1:7.5
15. Growing fat pigs:							
2–3	44 lbs.......	44	7.6	28.0	1.0	38.0	1:4.0
3–5	110 "	35	5.0	23.1	0.8	30.0	1:5.0
5–6	143 "	33	4.3	22.3	0.6	28.0	1:5.5
6–8	198 "	30	3.6	20.5	0.4	25.1	1:6.0
8–12	287 "	26	3.0	18.3	0.3	22.0	1:6.4

RATIONS FOR DAIRY COWS.

	Org'nic Matter.	Digestible.				Nut. Ratio.
		Protein	Carbo-hydrates	Fat.	Total.	
	lbs.	lbs.	lbs.	lbs.	lbs.	
Woods & Phelps.......	25.0	2.5	12.5	.65	15.65	1:5.6
Woll....................	24.5	2.2	13.3	.7	16.2	1:6.9
Wolff's German Stand'.	24.0	2.5	12.5	.4	15.4	1:5.4
Wolff-Lehmann...	(See page 12)					

CALCULATION OF COMPONENTS OF FEED RATIONS.

Let us suppose that we have at our disposal the following common feeding stuffs: Fodder corn, clover hay, and wheat bran, and that we want to know how much is required to keep a milch cow of 1000 lbs. live weight in good condition and to secure a maximum yield of milk. We will feed 15 lbs. of corn fodder, 5 lbs. of clover hay, and 10 lbs. of wheat bran. According to the table these quantities contain the following number of pounds of digestible matter:

	Dry Matter.	Digestible.	
		Protein.	Carbohy-drates and Fat.
	Lbs.	Lbs.	Lbs.
15 lbs. of corn fodder............	8.7	.38	5.4
5 lbs. clover hay................	4.2	.36	2.1
10 lbs. wheat bran...............	8.8	1.20	4.6
Total.....................	21.7	1.94	12.1

This ration falls somewhat short of the feeding standard in both total dry matter and digestible substances. To bring it nearer to the standard, we add a couple of pounds of some concentrated feed. In selecting the feeds and deciding the quantities to be given in each case, the market prices of the feeds must be considered. We will suppose that a supply of corn meal is available in this case, and will add two pounds of this feed to the above ration.

	Dry Matter.	Digestible.		Nutritive Ratio.
		Crude Protein.	Carbohydrates.	
	Lbs.	Lbs.	Lbs.	
Ration as above..........	21.7	1.94	12.1	
2 lbs. of corn meal........	1.7	.13	1.4	
Total...............	23.4	2.07	13.5	1 : 6.5
Proposed American feeding ration for milch cows...	24.5	2.2	13.3	1 : 6.9
Wolff's feeding standard for milch cows............	24.0	2.5	12.5	1 : 5.4

The ration now corresponds fairly well with the proposed American feeding ration; there is a small deficit of dry matter and of digestible protein; but there is no necessity of trying to follow any standard ration blindly, as they are only intended to be approximate gauges which the farmer may use in estimating the quantities of nutrients required by farm animals in order to do their best, cost and product both being considered. Cows, like all farm animals, vary greatly in their productive capacity, as well as in their food requirements, and their capacity to make economical use of their feed; hence feeding standards can only be applied to average conditions, a point which should always be kept in mind in using them.

In constructing rations according to the above feeding standards, several points must be considered besides the chemical composition and the digestibility of the feeding stuffs; the standards cannot be followed directly without regard to bulk and other properties of the fodder; the ration must not be too bulky, and still must contain a sufficient quantity of roughage to keep up the rumination of the animals, in case of cow and sheep, and to secure a healthy condition of the animals generally. The local market prices of cattle foods are of the greatest importance in determining which feeds to buy; the conditions in the different sections of our continent differ so greatly in this respect that no generalizations can be made. Generally speaking, nitrogenous concentrated feeds are the cheapest feeds in the South and the East, and flour-mill, brewery, and starch-factory-refuse feeds the cheapest in the Northwest.

PRACTICAL RATIONS FOR DAIRY COWS.

Fed by 16 American Dairymen Producing 325 lbs. of Butter or more per Cow per Year.*

1. *Colorado.*—30 lbs. silage, 10 lbs. alfalfa hay, 10 lbs. clover hay, 5 lbs. wheat bran, 2 lbs. corn meal.

2. *Connecticut.*—35 lbs. corn silage, 10 lbs. hay, 3 lbs. wheat bran, 3 lbs. corn and cob meal, 2 lbs. cotton-seed meal, 2 lbs Chicago gluten meal.

3. *Illinois.*—7½ lbs. clover hay, 7½ lbs. timothy hay, 12 lbs. corn and cob-meal, 8 lbs. bran, 1½ lbs. linseed meal, 1½ lbs. cotton-seed meal.

4. *New Jersey.*—24 lbs. corn silage, 8 lbs. corn meal, 2 lbs. wheat bran, 4 lbs. oats, 2 lbs. oil meal.

5. *New York.*—20 lbs. hay, 2 lbs. wheat bran, 2 lbs. cotton-seed meal, 2 lbs. hominy meal.

6. *New York.*—12 lbs. timothy hay, 1 lb. wheat bran, 1 lb. middlings, 2 lbs. corn meal, 2 lbs. cotton-seed meal, 40 lbs. skim-milk.

7. *New York.*—42 lbs. corn silage, 2½ lbs. clover hay, 2½ lbs. timothy hay, 8 lbs. corn and cob meal, 14 lbs. dried brewers' grains.

8. *North Carolina.*—30 lbs. corn silage, 8 lbs. fodder corn, 3 lbs. corn meal, 3 lbs. wheat bran, 1 lb. cotton-seed meal.

9. *Pennsylvania.*—24 lbs. corn fodder, 5.1 lb. wheat bran, 5.1 lbs. corn meal, 3 lbs. cotton-seed meal, 2 lbs. oil meal.

10. *Pennsylvania.*—10 lbs. corn fodder, 6 lbs. hay, 3½ lbs. wheat bran, 1½ lbs. cotton-seed meal, 1½ lbs. oil meal, 2½ lbs. corn meal.

11. *Texas.*—30 lbs. corn silage, 13½ lbs. sorghum hay, 1.3 lbs. corn meal, 2.6 lbs. cotton-seed meal, 2.2 lbs. cotton-seed, 1.3 lbs. wheat bran.

12. *Vermont.*—30 lbs. corn silage, 10 lbs. hay, 4.2 lbs. corn meal, 4.2 lbs. wheat bran, .8 lb. linseed meal.

13. *West Virginia.*—48 lbs. corn silage, 2½ lbs. corn and cob meal, 2½ lbs. ground wheat, 2½ lbs. oats, 2½ lbs. barley meal.

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* See Woll, "One Hundred American Rations for Dairy Cows," Bulletin No. 38, Wisconsin Agricultural Experiment Station.

14. *Wisconsin.*—26 lbs. corn silage, 10 lbs. clover hay, 5 lbs. timothy hay, 8 lbs. wheat middlings, 1½ lbs. oil meal.

15. *Wisconsin.*—50 lbs. corn silage, 5 lbs. sheaf oats, 5 lbs. corn fodder, 1 lb. clover hay, 1 lb. millet, 2.7 lbs. cotton-seed meal, 1.3 lbs. oil meal, 6 lbs. wheat bran.

16. *Canada.*—40 lbs. corn silage, 7½ lbs. clover hay, 3 lbs. straw. 1½ lbs. oats, 1½ lbs. barley, 1½ lbs. pea meal, 3 lbs. wheat bran, 1 lb. cotton-seed meal.

The preceding rations contain approximately the following amounts of nutrients, calculated for 1000 lbs. live weight:

No.	Organic Matter.	Digestible.				Nutritive Ratio.
		Protein.	Carbo-hydrates.	Fat.	Total.	
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1	31.09	2.70	15.78	.80	19.28	1 : 6.5
2	25.70	2.69	13.96	.97	17.62	1 : 6.0
3	22.09	2.37	12.06	.75	15.18	1 : 5.8
4	19.41	2.06	11.71	.87	14.64	1 : 6.5
5	26.19	2.36	13.78	.79	16.93	1 : 6.6
6	25.73	3.50	14.05	1.12	18.67	1 : 4.7
7	31.30	3.37	16.31	1.31	20.99	1 : 5.7
8	20.38	1.79	11.98	.80	14.57	1 : 7.7
9	26.52	2.53	15.74	.90	19.17	1 : 7.0
10	20.05	2.31	11.00	.72	14.03	1 : 5.4
11	26.58	2.21	12.31	1.30	15.82	1 : 6.9
12	24.23	1.86	14.03	.75	16.64	1 : 8.4
13	22.37	1.54	14.15	.72	16.41	1 : 10.2
14	31.00	3.01	16.02	.87	19.90	1 : 6.0
15	23.79	2.73	12.46	.99	16.18	1 : 5.4
16	22.96	2.08	12.17	.71	14.96	1 : 6.6

AVERAGE WEIGHTS OF CONCENTRATED FEEDING STUFFS.

Feeding Stuff.	One Quart Weighs.	One Pound Measures.
	Pounds.	Quarts.
Barley meal	1.1	.9
Barley, whole	1.5	.7
Beet pulp, dried	.55	1.8
Brewers' grains, dried	.6	1.7
Corn and cob meal	1.4	.7
Corn and oat feed	.7	1.4
Corn bran	.5	2.0
Corn meal	1.5	.7
Corn, whole	1.7	.6
Cottonseed meal	1.5	.7
Cottonseed	1.0	1.0
Distillers' grains, dried	.5-.7	2.0-1.4
Germ-oil meal	1.4	.7
Gluten feed	1.3	.8
Gluten meal	1.7	.6
Hominy meal	1.1	.9
Kafir meal	1.6	.6
Linseed meal, new process	.9	1.1
" " old process	1.1	.9
Malt sprouts	.6	1.7
Mixed feed (bran and middlings)	.6	1.7
Molasses beet pulp	.75	1.3
Oat feed	.8	1.3
Oat middlings	1.5	.7
Oats, whole	1.0	1.0
Rye bran	.6	1.7
Rye feed (rye bran and rye middlings)	1.3	.8
Rye meal	1.5	.7
Rye, whole	1.7	.6
Wheat bran	.5	2.0
Wheat feed, mixed	.6	1.7
Wheat, ground	1.7	.6
Wheat middlings ("flour")	1.2	.8
" " ("standard")	.8	1.3
Wheat, whole	1.9	.5

FOOD REQUIREMENTS OF FARM ANIMALS.

It is generally assumed in comparing the food requirements of the different classes of farm animals that one cow at pasture will eat about seven-tenths as much daily as a full-grown horse, or as much as two yearling colts, heifers, or young bulls, or as three to five calves, or four colts taken from the mare, or ten to twelve sheep, or as twelve to twenty three-months-old lambs, or as four to five swine. It may be figured that the quantity of pasture grass eaten by a cow per day, which of course will vary with the season and the condition of the pasture, will equal 25-30 lbs. of good meadow hay or 40 lbs. hay of inferior quality.

COMPARATIVE VALUE OF CATTLE FOODS.

Comparing concentrated foods with coarse feeds, one pound of the former may be considered a *food unit;* the quantity of grass eaten by one cow at pasture during one day is assumed equivalent to 12 to 13 food units during the early part of the summer, and to 4 food units in the late fall, 10 units being considered an average figure.

The following quantities of different feeding stuffs are considered approximately equivalent, as determined by European, largely Danish, feeding experience (Schroll):

1 lb. concentrated feed (cereals, mill refuse-feeds, oil meals, etc.) = 2½ to 3 lbs. of good meadow hay = 4 lbs. of poorer quality hay = 10 lbs. rutabagas = 12½ lbs. turnips = 6 lbs. potatoes = 10 lbs. green fodder = 6 lbs. buttermilk = 6 lbs. skim-milk = 12 lbs. whey = 1 lb. new milk. (See table on p. 19*a*, also Wis. Exp. Sta., Circ. 37.)

CALCULATED VALUE OF FRUITS COMPARED WITH HAY, GRAINS, ETC. (Jaffa and Anderson.)

100 lbs. of each of the fruits named below is equivalent to the amounts of the materials given in the columns to the right.	Wheat Straw.	Alfalfa Hay.	Oat Hay.	Corn.	Oats.	Wheat.	Wheat Bran.	Wheat Middlings.	Rice Bran.	Cottonseed Meal.
Fresh Fruits.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Apples	34	20	24	15	17	16	18	16	13	9
Oranges	33	19	23	14	16	15	17	15	12	8
Pears	40	23	30	17	20	19	20	19	15	11
Plums	50	30	36	22	25	24	26	24	20	14
Prunes	46	27	33	20	23	22	24	22	18	13
Apricots	40	23	29	17	20	19	20	19	15	11
Nectarines	43	26	30	19	22	21	23	21	17	12
Figs	50	30	37	23	26	25	27	25	20	14
Grapes	50	30	37	23	26	25	27	25	20	14
Watermelons	22	13	16	10	11	11	12	11	8	6
Nutmeg melons	19	11	13	8	9	9	10	9	7	5
Dried Fruits.										
Prunes	175	104	125	78	88	84	92	84	67	48
Apricots	194	115	138	86	97	93	102	93	74	53
Peaches	190	113	135	85	95	91	100	91	72	51
Figs	186	110	132	83	93	89	97	89	71	50
Raisins	216	128	153	97	108	103	111	103	82	59

AMOUNTS OF DIFFERENT FEEDS REQUIRED TO EQUAL ONE FEED UNIT. (Wis. Exp. Sta., Circ. 37.)

Feed.	Feed Required to Equal 1 Unit. Average, Lbs.	Range, Lbs.
Concentrates:		
Corn, wheat, rye, barley, hominy feed, dried brewers' grains, wheat middlings, oat shorts, peas, Unicorn Dairy Ration, molasses beet pulp	1.0	....
Cotton seed meal	0.8	....
Oil meal, Ajax Flakes (dried distillers' grains), gluten feed, soy beans	0.9	....
Wheat bran, oats, dried beet pulp, barley feed, malt sprouts, International Sugar Feed, Quaker or Sugarota Molasses or Dairy Feed, Sucrene Dairy Feed, Badger Dairy Feed, Schumacher Stock Feed, molasses grains	1.1	....
Alfalfa meal, Victor feed, June Pasture, alfalfa molasses feeds	1.2	....
Hay and Straw:		
Alfalfa hay, clover hay	2.0	1.5–3.0
Mixed hay, oat hay, oat and pea hay, barley and pea hay, red top hay	2.5	2.0–3.0
Timothy hay, prairie hay, sorghum hay	3.0	2.5–4.0
Corn stover, stalks or fodder, marsh hay, cut straw	4.0	3.5–6.0
Soiling Crops, Silage, and Other Succulent Feeds		
Green alfalfa	7.0	6.0–8.0
Green corn, sorghum, clover, peas and oats, cannery refuse	8.0	7.0–10.0
Alfalfa silage	5.0	....
Corn silage, pea vine silage	6.0	5.0–7.0
Wet brewers' grains	4.0	....
Potatoes, skim milk, butter milk	6.0	....
Sugar beets	7.0	....
Carrots	8.0	....
Rutabagas	9.0	8.0–10.0
Field beets, green rape	10.0	....
Sugar beet leaves and tops, whey	12.0	....
Turnips, mangels, fresh beet pulp	12.5	10.0–15.0

The value of *pasture* is generally placed at 8 to 12 units per day. on the average, varying with kind and condition.

POUNDS OF DRY MATTER, DIGESTIBLE MATTER, AND DIGESTIBLE PROTEIN TO BE FURNISHED IN RATIONS FOR DAIRY COWS. (Wis. Exp. Sta. Bul. 200.)

Live Weight, Lbs.	Dry Cows.	Production of Butter Fat per Day, Pounds.						
		Less than 0.5 lb.	0.5–.75	0.75–1.0	1.0–1.25	1.25–1.5	1.5–1.75	1.75–2
POUNDS DRY MATTER TO BE FURNISHED IN RATIONS.								
800	10.0	13.7	16.2	18.6	21.1	23.5	26.0	28.4
900	11.3	15.0	17.5	19.9	22.4	24.8	27.3	29.7
1000	12.5	16.2	18.7	21.1	23.6	26.0	28.5	30.9
1100	13.8	17.5	20.0	22.4	24.9	27.3	29.8	32.2
1200	15.0	18.7	21.2	23.6	26.1	28.5	31.0	33.4
1300	16.3	20.0	22.5	24.9	27.4	29.8	32.3	34.7
1400	17.5	21.2	23.7	26.1	28.6	31.0	33.5	35.9
1500	18.8	22.5	25.0	27.4	29.9	32.8	34.7	37.2
POUNDS DIGESTIBLE PROTEIN TO BE FURNISHED IN RATIONS.								
800	.56	1.04	1.35	1.66	1.97	2.29	2.60	2.91
900	.63	1.11	1.42	1.73	2.04	2.36	2.67	2.98
1000	.70	1.18	1.49	1.80	2.11	2.43	2.74	3.05
1100	.77	1.25	1.56	1.87	2.18	2.50	2.81	3.12
1200	.84	1.32	1.63	1.94	2.25	2.57	2.88	3.19
1300	.91	1.39	1.70	2.01	2.32	2.64	2.95	3.26
1400	.98	1.46	1.77	2.08	2.39	2.71	3.02	3.33
1500	1.05	1.53	1.84	2.15	2.46	2.78	3.09	3.40
POUNDS TOTAL DIGESTIBLE MATTER TO BE FURNISHED IN RATIONS.								
800	6.3	9.0	10.7	12.5	14.2	16.0	17.7	19.5
900	7.1	9.8	11.5	13.3	15.0	16.8	18.5	20.3
1000	7.9	10.6	12.3	14.1	15.8	17.6	19.3	21.1
1100	8.7	11.4	13.1	14.9	16.6	18.4	20.1	21.9
1200	9.5	12.2	13.9	15.7	17.4	19.2	20.9	22.7
1300	10.3	13.0	14.7	16.5	18.2	20.0	21.7	23.5
1400	11.1	13.8	15.5	17.3	19.0	20.8	22.5	24.3
1500	11.9	14.6	16.3	18.1	19.8	21.6	23.3	25.1

PRICES OF CEREALS PER BUSHEL AND PER TON.

Name.	Weight per Bushel.	Factor.	Price per Bushel.	Price per Ton (2000 lbs.).	Name.	Weight per Bushel.	Factor.	Price per Bushel.	Price per Ton (2000 lbs.).
	lbs.		$	$		lbs.		$	$
Wheat.	60	33.3	.40	13.33	Oats... ...	32	62.5	.18	11.25
			.45	15.00				20	12.50
			.50	16.67				.25	15.63
			.60	20.00				.30	18.75
			.75	25.00				.35	21.90
			1.00	33.33				.50	31.25
Corn...	56	35.7	.30	10.71	Rye...... ..	56	35.7	.40	14 28
			.35	12.50				.50	17.85
			.40	14.28	Barley.. ...	48	41.7	.40	16 68
			.45	16.06				.50	20.83
			.50	17.85				.60	25.02

VALUATION OF FEEDING STUFFS.

The commercial value of protein, fat, and carbohydrates in concentrated feeding stuffs has been calculated from the average composition and market price of common feeding stuffs as follows:

	Cost of one pound of— Protein.	Fat.	Carbohydrates.	
In Germany...(1890)	3:	2:	1	(König, Wolff.)
" Connecticut (1888)	1.6 cts.	4.2 cts.	.96 cts.	(Jenkins.)
" " (1890)	1.4	2.9	1.4	"
" Delaware...(1889)	1.23	4.45	.52	(Penny.)
" Wisconsin..(1891)	1.5	3.6	.5	(Woll.)
" Indiana ....(1891)	1.0	2.75	.63	(Huston.)
" New Jersey.(1891)	.91	5.91	1.12	(Voorhees.)
" Minnesota..(1893)	3.1	3.1	.24	(Hays.)
" Vermont....(1895)	2.02	— .19	.91	(Hills *et al.*)

II. FARM ANIMALS.

CHARACTERISTICS OF BREEDS OF LIVE STOCK.

By the late Prof. J. A. CRAIG, formerly of Iowa Agricultural College.

I. Light Horses.

The Thoroughbred.—Leading characteristics: running speed (Salvator, 1:35½, holds the world's mile record), quality, stamina, and ambition. Common colors: brown, bay, chestnut. Distinctive features: refined appearance, lengthy neck, deep chest, long body, straight croup, long thighs and pasterns, dense bone, firm muscle, active temperament, rangy type standing 16 hands. Most common defects: light bodies, lengthy pasterns, long legs, irritable temperament. Bred principally for racing, which has given them endurance and spirit. They are suited for mating with mares weighing 11 to 12 cwt., with the object of producing strong drivers or stylish carriage and saddle horses.

The American Trotter.—Chief characteristics: speed at the trotting gait. World's record for one mile against time is that of Alix, 2:03¾. The type of the leading campaigners is that towards which the trotter is tending; it is that of a horse required to have the endurance, ambition, and conformation to maintain trotting speed. Most general features: intelligent heads, light necks, low deep chests, oblique shoulders, long forearm, short cannons, round body rising slightly over loin, long croup and thighs, low hocks. Most common defects: undersize, deficiency in style, finish, and substance. Sphere: coach or carriage horses, roadsters, and trotters.

Cleveland Bay. — Uniform in color, being bay with black points. They stand at least 16 hands and are horses of larger size and more power than those of most other breeds of light horses. Rough joints, coarse bone, and deficiency in action are their most common defects. Their size, power, and evenness of disposition adapt them for general work on light farms, but owing to the defects mentioned they are not as popular for breeding road and carriage horses as those of other breeds.

French Coach.—Smooth, symmetrical, and generally of fine quality; very graceful in movement, with high knee-action and good back-action. Heads intelligent looking; necks graceful, bodies snugly ribbed, and quarters muscular. As a rule, they are striking in appearance, being upstanding and high-headed. Common colors: bay, brown, and black. Best suited for breeding coach-horses with moderately fast and graceful action. Defects: coarseness and lack of prepotency in the stallions due to their mixed breeding.

Hackney. — The typical hackney is a horse of extreme smoothness, with gracefully curved outlines. The head is light, neck muscular and curved, but free from heaviness; shoulders smooth and laid well back; body circular, compact, short; hips smooth; quarters plump with muscle; legs short, with tendons clearly defined. Their action is noted for its gracefulness and stylishness, being very high in the forelegs, and the hock movement is regular. Common colors: bay and brown. They are usually about 15.3 hands. Best suited for production of high-stepping cab and coach horses for city driving.

II. Heavy Horses.

Clydesdale.—Usual colors: bay, brown, black, or chestnut with white markings. The head is intelligent in features, but sometimes out of proportion with the other parts. Shoulder exceptionally good; being sloping, it gives them a free, easy, and long stride in the walk or trot; arm well-muscled, and legs clean and flat, with the fine and long feather springing from the edge; pasterns sloping, easing the feet from concussion;

feet large and durable. The croup is muscular and the quarters especially heavily-muscled. Their combination of weight, quality, and action is exceptional in draught-horses.

Shire.—The best type is low, broad, and stout. They are heavily built, muscular, with heavy bone and slow movement. The shoulder is usually too upright, making the action too short and stilted. The body is of large girth, deep and strongly coupled, with broad, short back and heavily-muscled quarters. Deficiencies: lack of quality, sluggish temperament, and limited action. In general they are heavier than the Clydesdale, though there is little difference between representative animals. The best type is suitable for breeding the heaviest class of draught-horses adapted to slow work demanding strength and heavy weight.

Percheron. — Types: the original gray in color, and the modern of black color. Most peculiar characteristics of the former were their action, style, endurance, and strength. They had intelligent heads, prominent chests, round bodies, large bone, inclined to roundness. The modern type is shorter-legged, more compact and stouter, but lacking the size of the original. The Percheron's excellencies are seen in their active temperament, intelligent heads, crested neck, deep body, and wide croup. Their deficiencies appear in defective legs, being light or round, straight pasterns, feet narrow at the hoof, heads and quarters lacking muscle. Best type adapted for breeding energetic, quick-gaited, strong horses suited for draught work of light nature.

Suffolk.—Color uniform, being some shade of chestnut. They are low-set, short-legged, deep-bodied, muscular horses, with clean bone and durable feet; docile, easy keepers, and steady when working. General deficiency: a lack of weight due to their smaller size in comparison with other draught-horses. Suited for general farm labor; they are not the highest-priced horses on the market owing to the demand for heavier weights.

III. Beef Cattle.*

Short-horns.—The three family types are: Bates, Booth, and Cruikshank. *Bates*, noted for style, fine heads, clean necks, straight level backs, light bone, and combination of milk and beefing qualities. *Booths* are especially excellent in girth, wide backs, lengthy quarters, deep flesh, and beefing qualities, though lacking in finish and style. *Cruikshanks*, noted for scale; low, broad, deep forms, heavy flesh, and mossy coats. The short-horn breed is specially noted for beef form, early maturity, and thrift under a variety of conditions. Their weakness in constitution and sterility is traceable to in-and-in breeding and artificial treatment. Their chief utility is to give beef form, quality, and rapid fattening tendencies to grades for stall feeding. Some families possess unequalled combination of beefing and milking qualities.

Aberdeen Angus. — Characteristic color, black. Head, hornless; neck free from loose skin, exceptionally good shoulder-vein; shoulder oblique, fitting close to body; ribs deep, very circular; hips moderately far apart, smoothly curved; rump long, level, smooth; thighs muscular, twist low and full, quarters long and rounded. Type: cylindrical, distinguished for smoothness, symmetry and quality; bone light, hide mellow, and coated with fine black hair. They are prepotent and prolific. Chief utility, production of beef of high quality.

Hereford.—Most popular color, dark claret or cherry, with white face, belly, switch, and small strip of white on neck and over shoulder. Type: low-set and broad; heavy in forequarters, with low heads; full, deep chest; hanging dewlap, level lack, wide thick loin, full quarters and thin thighs. Worst deficiencies, looseness in build and rough, coarse bone. They are strong-constitutioned, active rangers, prepotent and long-lived. Being active, hardy, and good feeders they make good grazing cattle, and on that account have been popular on ranches.

Galloway. — Color black, no white admissible, except on

* For description of breeds of dairy cattle, see Part II, Dairying.

udder or below underline. Type: thick, close to ground, and symmetrical; hair long, wavy, and thick; head large, hornless, with no scurs; neck strong, giving a burly appearance to forequarters; shoulders snug, legs short and heavy, barrel round, tight-ribbed; quarter long and smooth; flesh even over all parts; hardiness and strength of constitution, strong features. Require more time to mature and yield larger percentage of offal than most other breeds. They are liked as ranch cattle, as they are hardy, hornless, and yield excellent beef and robes.

IV. Fine-wooled Sheep.

Merino.—The two types include those wrinkled and those smooth in body. They are chiefly noted for the heavy weights of fine wool that they shear. The fleece is dense, even, extending over all regions. The wool is bright, soft, fine, lustrous, and pure. They are hardy and strong in constitution, of a quiet disposition, and do well in large flocks.

V. Mutton Sheep.

Southdown.—Symmetrical, compact, close to the ground, and of fine quality; head medium size, hornless; forehead and face covered with wool, ears small, face brown or gray tint, neck short, breast broad, back and loin wide and straight, body deep, hips wide, twist full, fleece dense, and medium in length and fineness. The mutton is of high quality, and lambs mature early. They represent an exceptional combination of wool and mutton of fine quality.

Shropshire.—Face and legs dark brown in color. They are symmetrical and stylish. Rams are required to weigh 225 lbs. in full flesh, and ewes 175 lbs. Head short, covered with wool, hornless; neck well attached, full; body circular, round ribbed; quarters lengthy, inclined to narrowness and slackness. The fleece dense, fibre strong, about three and one half inches in length. The ewes are prolific and kind nurses. They combine quality and quantity of wool and mutton in a high degree, and are adapted to conditions of general farming and rolling land.

Hampshire.—Color of face dark brown or black; head large, nose prominent, neck regular, taper from head to shoulder;

strong-boned and lengthy. Especially noted for early development of lambs. They are vigorous and prepotent. The wool is short, dense, strong, and slightly coarse.

Suffolk.—Faces and legs deep black color. They are large sheep when mature; lengthy and straight in form. Noted chiefly for prolificness and good milking and nursing qualities. A large percentage of lambs are reared in flocks of this breed; wool medium in quality and length.

Oxford.—Face either brown or gray, and lengthy. When mature they are the heaviest of the Down breeds, being larger in size and heavier in bone. Their fleece is also heavier and the fibre longer, coarser, and more open than most others. Squarer in form than the Shropshires, and not so closely covered with wool. Adapted to strong land; respond readily to high feeding.

Leicester.—Face bare and pure white, body square, straight, forequarters exceptionally full, hindquarters rounded slightly. Offal is light, bone fine, but fat too plentiful. The Border type is stronger boned, heavier, and more vigorous than the English. The Leicester has been extensively used for crossing on grades. Wool lustrous, five or six inches long, soft, but too frequently open and absent on the belly.

Cotswold.—Face white or slightly mixed with gray. Form large, square, upstanding, and stylish. A tuft of wool grows from forehead; fleece open, long, and heavily yielding. Body long, level, and wide. The gray-faced strain is considered hardier than the white-faced. The popularity of the breed lies in the large yield of wool and of mutton, though the quality of both is deficient.

Lincoln.—The largest of the long-wooled breeds. The wool is long and coarse, and especially lustrous. Square in form and, when mature, very heavy. The mutton lacks quality.

Cheviot.—Face bare, white, hornless; wool fine, and the fleece dense and even. Mutton agreeably flavored and fine-grained. They are hardy, active, prolific, and the lambs come active. They clip about four pounds of fine wool. Adapted to rough and high pasturage.

Dorset.—Face white; rams and ewes horned. Type: long, round-bodied, and compactly built. Wool medium in length, fineness, and weight; average clip 6 pounds. Chief character-

istics: prolificness, hardiness, and breeding early, so as to drop lambs in winter.

Highland.—Rams and ewes horned, face and legs black and white. Low and blocky in type; fleece long, coarse. Their mutton has a superior flavor. Mountain breed hardy, active, and very strong of constitution.

VI. Swine.

Berkshire.—Color black, white on face, feet, tip of tail. Face short, dished; ears sharp-pointed, erect; jaws full, back broad, straight, full over shoulder; loin thick, level; hams exceptionally full, legs short, strong, and straight. Sows prolific, good nurses. Active and vigorous in temperament.

Poland-China.—Color dark, spotted, or black; head small, slightly dished; ears drooping, girth full, ribs well sprung, deep; hindquarters lengthy, though inclined to be drooping. They fatten readily, reach heavy weights, and are quiet-dispositioned.

Yorkshire.—White in color; separated into large, middle, and small varieties. The first-mentioned, are strong-boned, long-bodied, and deep-sided, and have mixed meat; middle or improved type, lighter in weight and bone, with smaller quantity of offal; small variety, quick in maturing and compact in form.

Chester-White.—White in color, strong-boned, vigorous, and attain to very heavy weights, though slow in maturing. Sows of good disposition and breeding qualities.

Duroc-Jerseys.—Deep, cherry red in color, large size, good breeders, and liked in Southern countries because of ability to withstand heat.

Victoria.—White in color with occasional black spots on skin; head small, face slightly dished; skin free from scurf; flesh of good quality and evenly laid over body. Yearling boars should weigh not less than 300 lbs.

Tamworth.—Red or dark brown color; snout very long, body narrow, exceptionally deep and long in sides. Their form and the mixture of fat and lean in their flesh make them a special bacon hog.

Essex.—Color black; type: small, compact, early maturing, and yielding a large percentage of edible meat.

MARKET CLASSES OF FARM ANIMALS.

A.—Horses.

Drafters.—A typical draft horse, so considered in the market, should stand 16 hands or over; light draft horses range in height from 15.3 to 16.1 hands. Drafters should weigh 1600 lbs. and over in fair condition. Heavy weight in addition to desirable conformation, soundness, and action enhances value.

Loggers.—Horses of this class are heavy drafters, possessed of weight, great power, and strength of bone, but blemished or slightly unsound so that they cannot be sold to advantage for use in the cities. Largely bought by lumbermen for use in the woods.

Farm chunks.—These are usually of mixed draft blood, stand 15 hands or over and weigh 1100–1500 lbs.

General-purpose Horses.—These animals are not recognized as a standard market class, but form a large proportion of the entire number of horses marketed. They usually are serviceably sound and often of fair to good quality, but they lack the characteristics fitting a horse for a distinct market class.

Expressers.—This class comprises active, light draft horses that are expected to do most of their work at a trot. The typical expresser stands 15.2 to 16 hands, and weighs 1350 to 1500 lbs. or over, according to the class of work to be done. They are commonly considered "draft horses with coach-horse finish."

Bussers.—Horses of this class stand 15.1 to 15.3 hands and weigh 1200–1400 lbs. Their chief work is done at a trotting gait, hence they must be active, energetic, straight, and somewhat stylish in carriage and gait. Many go abroad to serve as ' trammers."

Artillery Horses.—In this class geldings are required. They should be uniform, of a hardy color, from 15½ to 16 hands high, quick and strong in action, well-bred, of a kind disposition, square trotters, well broken to harness, gentle under saddle, with easy mouths and gait. They should weigh 1100–1250 lbs. and be from 5 to 8 years old.

Drivers.—The typical roadster should stand 15.1 to 15.3 hands high and weigh 950 to 1150 lbs. His purpose is to draw a light buggy on the road at a fairly rapid rate of speed for a considerable length of time. He should be graceful in form and action sprightly, pleasing, straight, and smooth in all gaits, his disposition good, and his legs and feet sound.

Standard Bred.—This class includes trotters and pacers eligible to record in the trotting register and possessed of notable speed, and breed prepotency in that direction.

Coachers.—A typical coacher stands 15.2 to 16 hands and weighs 1100 to 1250 lbs. He should have high knee action and corresponding high hock action that comes from breeding rather than artificial methods of development. He must move fairly fast with much gracefulness of carriage, possess fine quality, be beautifully molded in all of his curves, and carry his head and tail high. While heavier, smoother, and more compact than the roadster, he must be showy and stylish to carry fine harness and draw handsome equipages.

Wagon Horses.—These are used for parcel-delivery service by large department stores, etc.; they are big overgrown coachers, stand 16.1 hands and weigh 1250 lbs.

Cobs.—A typical cob stands about 15.1, weighs 1000 to 1050 lbs., is more compact and blocky than the coacher, yet must have style and beauty in a marked degree. His action must be extremely high and "trappy."

Saddlers.—These horses vary considerably in type, size, and weight, but are, as a rule, 15.1 to 15.3 hands high and weigh 1000 to 1150 lbs. They should have great style and quality, smooth conformation, natural and thoroughly trained saddle gaits, intelligent, clean-cut countenances, sloping pasterns and shoulders, moderately high and narrow withers, short strong-coupled backs, strong and muscular thighs, and well-carried heads and tails. "Walk, trot, and canter" saddlers have become popular of recent years and sell at high prices. (See Alexander, Bull. No. 127, Wisconsin Experiment Station; also Obrecht, Bull. No. 122, Illinois Exp. Station.)

B.—Cattle.

General Classes.

1. *Beef Cattle.*—This class includes all grades of fat steers and heifers; also everything from common to prime and from light to heavy. It is finished condition that brings animals into this class.

2. *Butcher Stock.*—This class includes animals that have not fattened well; also animals that have not been fed long enough to become properly fattened. It seldom includes steers of really good quality, as such will usually be sold as feeders. The bulk of butcher stock is made up of cows and heifers.

3. *Cutters and Canners.*—In this class are included old thin cows and very thin bulls, steers, and heifers. The cutters must carry sufficient flesh to permit of the loin or rib or both being used for cutting on the block. Those animals which are so thin that no part of the carcass can be used for block purposes constitute the canners.

4. *Stockers and Feeders.*—This class includer calves, yearlings, two-year-olds, and older cattle. Cattle 18 months old or older, which are ready for immediate use in the feed lot, are called feeders. Those which are younger are referred to as stockers.

5. *Veal Calves.*—This includes all calves which are sold for immediate slaughter.

Special Classes.

In addition to the preceding general classes, a number of special classes are generally recognized and require to be named and defined.

1. *Texas and Western Range Cattle.*—A few years ago the typical Texas steer had very long horns and legs, was thin and narrow bodied, and carried a large deep brand; and most of the cattle which came from Texas were of this description. But this type is rapidly disappearing. Animals of the best beef breeds have been imported into the State and used for breeding purposes, especially for crossing with the native stock, so that now many of the Texas cattle compare favorably with those from other sections of the country. There is, however, a wide range between the best and the poorest.

The Western range cattle are classed with the Texas cattle, because formerly they were made up largely of Southern cattle which were driven northward to winter on the ranges north of the quarantine line. Now, however, a large percentage of the animals in this class are bred on the ranges of the West and Northwest. All the cattle in this class are branded.

2. *Distillers.*—These are cattle that have been fattened on the by-products of distilleries. Formerly only inferior grades of cattle were purchased for feeding on distillery residues, but at present many feeders of better grades are used. When sent to market these cattle are preferred to many of the same grade, because they dress out a higher percentage of beef.

3. *Baby Beef.*—This term applies to choice or prime fat steers between 1 and 2 years old, weighing from 800 to 1000 lbs.

4. *Export Cattle.*—The cattle exported are in the main good to choice steers, weighing from 1200 to 1500 lbs. Comparatively few prime beef steers are brought for export, because of the high price they bring in the home market.

5. *Shipping Steers.*—This term applies to the animals purchased in the Western markets for shipment to the large Eastern markets of the United States. They are mainly of medium and good grades, and range in weight from 1150 to 1600 lbs.

6. *Dressed Beef Cattle.*—This class includes such cattle as are purchased by the large packing firms of the Middle West. The packers prefer medium to choice steers, weighing from 1200 to 1400 lbs., to make up the bulk of their purchases, but conditions of supply and demand cause them to purchase animals of a much wider range in grade and weight, the extreme range in weight being from 800 to 1700 lbs.

7. *Stags.*—This class includes such animals as have reached or at least approached maturity before castration and hence have the general conformation of bulls. Comparatively few of these come to the general markets, and they are of a wide range in quality, condition, and weight. A few are good enough for export, while the poorest must be sold for canners. (See Mumford, Bull. No. 78, Illinois Experiment Station, also Plumb, Marketing Live Stock, Farmers' Bull. No. 184.)

C.—Sheep.

The market classification of sheep varies considerably in the different markets of our country. Ordinarily they are, however, classed as follows: Western wethers, ewes, yearlings, and lambs, and native wethers, ewes, and lambs. These terms are self-explanatory. Western sheep are from the ranges of Montana, Wyoming, and other States beyond the Mississippi, and are strongly impregnated with merino blood. They lack the middle wool or mutton characteristics of sheep from States east of the Mississippi. Western sheep and lambs weigh lighter and dress out less fat than Eastern stock.

The various classes are graded on a range of quality, from common to choice or extra prime. (See Plumb, Farmers' Bull. No. 184, and Coffee, Bull. No. 129, Ill. Exp. Station.)

D.—Swine.

Prime Heavy Hogs.—These are prime heavy fat-back hogs, weighing 350–500 lbs., the extreme of the fat or lard hog. Prime implies marked evidence of ripeness and maturity.

Butcher Hogs are principally barrows; they are used for the fresh-meat trade; about 25 per cent. of the hogs coming to Chicago are of this class; they range in age, with good care and feeding, from about 6 months for the light butchers to one year for the heavy ones. They are subdivided into heavy, 280–350 lbs.; medium, 220–280 lbs.; and light butchers, 180–220 lbs. The heavy butchers include prime and good grades, and the two latter subclasses, prime, good, and common grades.

Packing Hogs.—These are, as a whole, of a poorer grade than the butcher hogs. They include old brood sows, and all other hogs that are heavy enough for this class and not good enough for the butcher class, except the poorer classes, such as roughs, boars, and coarse stags. About 40 per cent of the hogs on the Chicago market are of this class. They range in age upwards to about 9 months and weigh in the three subclasses, 200–280, 250–300, and 300–500 lbs., each of these being graded as good, common, or inferior stock.

Light Hogs.—This class includes all hogs within the weight limits of 125 and 220 lbs., except roughs, stags, and boars, which

form separate classes. About 15 per cent of the hogs on the Chicago market belong here. They range in age from 5 to 8 months, and vary considerably in form, quality, and condition, hence the subclasses are of more importance than in the preceding classes.

Bacon Hogs are used for the production of bacon, which is pork that has been salted and then smoked. English bacon hogs weigh 160–220 lbs. and United States, 155–195 lbs. The latter are graded as choice, good, and common.

Light Mixed Hogs.—This is a somewhat miscellaneous class, comprising about 55 per cent of the light hogs on the Chicago market. This class is the "dumping ground" for the outcasts of the two former classes of hogs. They range in age from 5 to 7 months, and weigh 150 to 220 lbs. They are principally used for the fresh-meat trade.

Light Light Hogs.—Hogs in this class range in weight from 125 to 150 lbs., and in age from 5 to 6 months. About 25 per cent of the light hogs on the Chicago market belongs to this class and are used mainly for the fresh-meat trade. This and the preceding subclass include hogs of good, common, and inferior grades.

Pigs range in weight from 60 to 125 lbs., and in age from 3½ to 6 months. They are choice, good, or common pigs in proportion to their approach to the ideal of a fat hog.

Roughs.—This class includes hogs of all sizes that are coarse, rough, and lacking in condition. The pork from these hogs is used for the cheaper trade for both packing and fresh-meat purposes.

Stags.—These are hogs that were boars beyond the pig stage and have been subsequently castrated. They sell with a dockage of 80 lbs. According to their freedom from stagginess and their quality and condition, these hogs are sold in the class with the various grades of packing hogs or with boars.

Boars.—These are always sold in a class by themselves, and bring from two to three dollars per cwt. less than the best hogs on the market at the same time. The pork from these hogs is used to supply the cheaper class of trade and also for making sausage.

Miscellaneous Classes: Roasting Pigs.—Three to six weeks old and weighing 15 to 30 lbs. They come to market in small numbers and only during the holiday season. They are usually of a very uniform grade and command prices ranging from those paid regular live hogs to that paid for poultry.

Feeders.—These are hogs that are bought on the market and taken back to the country to be further fed. This class is of but small importance, as this practice of feeding is followed only to a very small extent.

Governments.—These are hogs that are not considered sound in every respect by the Government inspectors, and are retained for further inspection. They are usually bought by local dealers and taken to one of the smaller packing houses, where they are slaughtered under the supervision of an inspector. If their flesh is found unfit for human food, they are tanked and used for fertilizers.

Pen Holders are long-legged hogs of poor form, coarse in quality, and much lacking in condition, kept at the stock yards simply for the purpose of holding pens for commission men.

Dead Hogs.—These are hogs killed in transit, and are used for the manufacture of grease, soap, and fertilizers. If they weigh 100 lbs. or over, they sell for 75 cents per cwt.; if less, they furnish no revenue to the producer or shipper, the cost of handling them being held equal to their value. (See Dietrich, Bull. No. 97, Illinois Experiment Station.)

TABLE FOR ESTIMATING LIVE WEIGHT OF CATTLE. (WHITCHER.)

Girth in Feet and Inches.		Store Cattle.		Medium Fat.	
		Fair Shape.	Good Shape.	Fair Shape.	Good Shape.
Ft.	In.	Lbs.	Lbs.	Lbs.	Lbs.
5	0	650	700	700	750
5	1	675	725	725	775
5	2	700	750	750	800
5	3	725	775	775	825
5	4	750	800	800	850
5	5	775	825	825	875
5	6	800	850	850	900
5	7	825	875	875	925
5	8	850	900	900	950
5	9	875	925	925	975
5	10	900	950	950	1000
5	11	925	975	975	1025
6	0	950	1000	1000	1050
6	1	1000	1050	1050	1100
6	2	1050	1100	1100	1150
6	3	1100	1150	1150	1200
6	4	1150	1200	1200	1250
6	5	1200	1250	1250	1300
6	6	1250	1300	1300	1350
6	7	1300	1350	1350	1400
6	8	1350	1400	1400	1450
6	9	1400	1450	1450	1500
6	10	1450	1500	1500	1550
6	11	1500	1550	1550	1600
7	0	1550	1600	1600	1650
7	1	1600	1650	1650	1700
7	2	1650	1700	1700	1750
7	3	1700	1750	1750	1800
7	4	1750	1800	1800	1850
7	5	1800	1850	1850	1900
7	6	1850	1900	1900	1950

DETERMINATION OF THE AGE OF FARM ANIMALS BY THEIR TEETH.

(U. S. Department of Agriculture.)

Horse.—The horse has 24 temporary teeth. The male has 40 permanent teeth, the female 36 or 40. The smaller number is more usual in females, due to the lack of the tusks. The temporary teeth consist of 12 incisors and 12 molars; the 4 center front teeth, 2 above and 2 below, are called pinchers; the next 4 are called intermediate or lateral, and the next 4 corner teeth. The permanent teeth consist of 12 incisors, 4 tusks, and 24 molars. The dental star is a yellowish ring appearing next the enamel on the table or crown of the tooth. The following table shows approximately the changes of the teeth with age:

3 to 10 days: Temporary pinchers and 3 molars cut.
40 to 60 days: Temporary intermediates or laterals cut.
6 to 9 months: Temporary corner teeth cut.
19 to 25 months: Leveling of temporary corner teeth.
2½ to 3 years: Pinchers replaced by permanent teeth.
3½ to 4 years: Intermediates or laterals replaced.
4 to 4½ years: Tusks cut.
4½ to 5 years: Corner teeth replaced.
5 to 6 years: Leveling of lower pinchers.
7 years: Leveling of permanent intermediates.
8 years: Dental star and notches in pinchers.
9 years: Dental star in intermediates.
10 years: Dental star in corner teeth.

Cattle.—Cattle have 20 temporary and 32 permanent teeth. The temporary are 8 incisors in the lower jaw and 12 molars. The permanent teeth are 8 incisors and 24 molars. Cattle have no incisors in the upper jaw. The table for cattle is as follows:

At birth: Temporary incisors appear.
5 to 6 months: Teeth decayed on border.
6 to 7 months: Leveling of pinchers.
12 months: Leveling of first intermediates.
15 months: Leveling of the second intermediates.
18 months: Intermediate incisors become stumps.

2 years: Permanent pinchers cut.

2½ to 3 years: Permanent first intermediates cut.

3½ years: Second intermediates or laterals cut.

4 years: Corner teeth replaced.

5 to 6 years: Leveling of permanent pinchers.

7 years: Leveling of first intermediates.

8 years: Leveling of second intermediates.

9 years: Leveling of corner teeth.

10 to 12 years: Dental star in pinchers and intermediates.

13 years: Dental star in corner teeth.

Sheep.—Sheep have 20 temporary and 32 permanent teeth. The table for changes is as follows:

1 month: Milk incisors appear.

3 months: Milk incisors decayed on border.

15 months: Permanent incisors cut.

2 years: First permanent intermediates cut.

33 months: Second permanent intermediates cut.

40 months: Corner teeth cut.

Hogs.—Hogs have 28 temporary and 44 permanent teeth. The table for changes is as follows:

At birth: Temporary corner incisors cut.

1 to 2 months: Temporary central incisors cut.

3 months: Temporary lateral incisors cut.

9 to 12 months: Permanent corner incisors cut.

12 to 15 months: Permanent central incisors cut.

18 to 20 months: Permanent lateral incisors cut.

BODY TEMPERATURE OF FARM ANIMALS.

(Dammann.)

	Deg. F.		Deg. F.
Horse..........	99.5–101.3	Swine..........	101.3–104.0
Cattle..........	100.4–103.1	Dog............	99.5–103.1
Sheep..........	101.3–105.8		

The temperature is greater after exercise than after rest, and in the evening, as a rule, 0.2–1.1° F. higher than in the morning.

DURATION AND FREQUENCY OF HEAT IN FARM ANIMALS. (Wolff.)

	In Heat for	If not Impregnated, Heat will Recur after	After Coming In, Heat will Recur after
Mares............	5–7 days	3–4 weeks	5–9 days
Cows	2–3 "	3–4 "	21–28 "
Ewes............	2–3 "	17–28 days	7 months
Sows............	2–4 "	9–12 "	4–5 weeks*

* 8–9 weeks at the latest.

PERIOD OF INCUBATION OF POULTRY.

Name of Fowl.	Days.	Name of Fowl.	Days.
Common hen.........	21	Goose..............	30
Pheasant............	25	Partridge..........	24
Duck, common.......	28	Duck, Barbary......	30
Pea fowl............	28	Turkey............	28
Guinea..............	25		

GESTATION CALENDAR.

Average Gestation Period.

Mares,	48½ weeks	(340 days,	extremes	307	and 412	days).
Cows,	40½ "	(283 "	"	240	" 311	").
Ewes,	22 "	(150 "	"	146	" 157	").
Sows,	16 "	(112 "	"	109	" 143	").

Time of Service.	Mares, 340 Days.	Cows, 283 Days.	Ewes, 150 Days.	Sows, 112 Days.
Jan. 1	Dec. 6	Oct. 10	May 30	April 22
" 6	" 11	" 15	June 4	" 27
" 11	" 16	" 20	" 9	May 2
" 16	" 21	" 25	" 14	" 7
" 21	" 26	" 30	" 19	" 12
" 26	" 31	Nov. 4	" 24	" 17
" 31	Jan. 5	" 9	" 29	" 22
Feb. 5	" 10	" 14	July 4	" 27
" 10	" 15	" 19	" 9	June 1
" 15	" 20	" 24	" 14	" 6
" 20	" 25	" 29	" 19	" 11
" 25	" 30	Dec. 4	" 24	" 16
Mar. 2	Feb. 4	" 9	" 29	" 21
" 7	" 9	" 14	Aug. 3	" 26
" 12	" 14	" 19	" 8	July 1
" 17	" 19	" 24	" 13	" 6
" 22	" 24	" 29	" 18	" 11
" 27	Mar. 1	Jan. 3	" 23	" 16
April 1	" 6	" 8	" 28	" 21
" 6	" 11	" 13	Sept. 2	" 26
" 11	" 16	" 18	" 7	" 31
" 16	" 21	" 23	" 12	Aug. 5
" 21	" 26	" 28	" 17	" 10
" 26	" 31	Feb. 2	" 22	" 15
May 1	April 5	" 7	" 27	" 20
" 6	" 10	" 12	Oct. 2	" 25
" 11	" 15	" 17	" 7	" 30
" 16	" 20	" 22	" 12	Sept. 4
" 21	" 25	" 27	" 17	" 9
" 26	" 30	Mar. 4	" 22	" 14
" 31	May 5	" 9	" 27	" 19
June 5	" 10	" 14	Nov. 1	" 24
" 10	" 15	" 19	" 6	" 29
" 15	" 20	" 24	" 11	Oct. 4
" 20	" 25	" 29	" 16	" 9
" 25	" 30	April 3	" 21	" 14
" 30	June 4	" 8	" 26	" 19
July 5	" 9	" 13	Dec. 1	" 24
" 10	" 14	" 18	" 6	" 29
" 15	" 19	" 23	" 11	Nov. 3
" 20	" 24	" 28	" 16	" 8

GESTATION CALENDAR.—(*Continued.*)

Time of Service.	Mares, 340 Days.	Cows, 283 Days.	Ewes, 150 Days.	Sows, 112 Days.
July 25	June 29	May 3	Dec. 21	Nov. 13
" 30	July 4	" 8	" 26	" 18
Aug. 4	" 9	" 13	" 31	" 23
" 9	" 14	" 18	Jan. 5	" 28
" 14	" 19	" 23	" 10	Dec. 3
" 19	" 24	" 28	" 15	" 8
" 24	" 29	June 2	" 20	" 13
" 29	Aug. 3	" 7	" 25	" 18
Sept. 3	" 8	" 12	" 30	" 23
" 8	" 13	" 17	Feb. 4	" 28
" 13	" 18	" 22	" 9	Jan. 2
" 18	" 23	" 27	" 14	" 7
" 23	" 28	July 2	" 19	" 12
" 28	Sept. 2	" 7	" 24	" 17
Oct. 3	" 7	" 12	Mar. 1	" 22
" 8	" 12	" 17	" 6	" 27
" 13	" 17	" 22	" 11	Feb. 1
" 18	" 22	" 27	" 16	" 6
" 23	" 27	Aug. 1	" 21	" 11
" 28	Oct. 2	" 6	" 26	" 16
Nov. 2	" 7	" 11	" 31	" 21
" 7	" 12	" 16	April 5	" 26
" 12	" 17	" 21	" 10	Mar. 3
" 17	" 22	" 26	" 15	" 8
" 22	" 27	" 31	" 20	" 13
" 28	Nov. 1	Sept. 5	" 25	" 18
Dec. 2	" 6	" 10	" 30	" 23
" 7	" 11	" 15	May 5	" 28
" 12	" 16	" 20	" 10	April 2
" 17	" 21	" 25	" 15	" 7
" 22	" 26	" 30	" 20	" 12
" 27	Dec. 1	Oct. 5	" 25	" 17
" 31	" 5	" 9	" 29	" 21

Directions.—Find the date of breeding in the first column, and follow the horizontal line in which it appears until the date in the proper column (Mares, Cows, etc.) is reached. If bred, e.g., July 26, add one day to the required date; if July 27 or 28, add 2 or 3 days, as the case may be.

FEEDING AND GENERAL CARE OF POULTRY.

By Prof. WM. P. WHEELER, of N. Y. (Geneva) Experiment Station.

Of the kinds of land birds and of water fowls under domestication the common "barnyard" fowls, of one general type, but of countless individual variations, and their pure-bred varieties, are those usually thought of when the subject of poultry is mentioned, and these are the fowls of most general practical interest. It is remarkable that the common fowl, although so widely bred, and for so long, in Europe and America has no distinctive English name.

Ducks, turkeys, and geese constitute greater or smaller portions of the market poultry according to the particular locality and season, but the common fowl, besides producing most of the table poultry, is almost alone called upon for the egg supply.

The relative prices of eggs and market poultry, the proximity of markets, as well as the prices of foods, determine the relative profit in keeping larger or smaller breeds, even with eggs as the special object. The meat value of every fowl is of consideration sooner or later, and while the smaller hens will produce eggs cheaper, the greater net profit from hatching to market per hen may be with the larger breed.

Most of the pure-bred varieties have their characteristics fairly established, so that it is better business policy to employ them rather than the uncertain mongrels, which, besides their unknown capabilities, are not less likely to suffer from long and careless inbreeding. The fancier who is fitted by judgment and experience to inbreed his stock closely will know how far he can go with safety; but one who finds it necessary to inquire about the advisability of inbreeding had better not attempt any.

Among the breeds that lay white-shelled eggs, Hamburgs, when of vigorous ancestry, probably are the most prolific. They certainly are exceptional layers, although the size of the egg is small. The Hamburg varieties possess in unusual degree pure-bred characteristics. Occasional complaints have been made in recent years concerning their stamina.

For egg production the Leghorns are typical fowls, and where white-shelled eggs are wanted, the Leghorn varieties are more widely kept than any others.

The Minorcas, other members of the Mediterranean class, excel the Leghorns in size of eggs, but do not equal them in number.

Some strains of several newer breeds are not far from the Leghorn in prolificacy.

Of the French breeds the Houdan is most widely bred in this country, and, for such an excellent table fowl, is an exceptional layer of large white eggs.

The Polish, often good layers, have sometimes suffered in vigor because of their beauty, which admirers hesitate to risk marring by introduction of distant blood.

Of the Asiatics, which lay brown-shelled eggs, the Langshan is high in favor with practical poultrymen. The Brahma, the largest of the pure breeds, also ranks high and lays large eggs. Those strains, however, bred for early laying are usually much inferior in size to the standard birds. The Cochin varieties are more particularly the pride of the fancier than of the farmer.

Of the American breeds the Plymouth Rock is undoubtedly the most popular. Its type of plumage possessses an unusual strength, even in blood much diluted, and faint reflections of the blue barring are seen in very distant relatives of the pure breed. The perfect markings of the showroom bird are, however, quickly lost. The American breeds lay brown-shelled eggs. Different flocks vary as much as the breeds or varietie in productiveness.

Many other breeds and varieties recognized by the American Poultry Association are of considerable economic value, but are less commonly kept.

In feeding most farm animals the usual purpose is only to secure meat, wool, milk, or work, and not always is consideration necessarily given to the breeding condition and the breeding season. When poultry is kept for other than fancy purposes, the life of the individual fowl is so short that there is not only an annual necessity of growing young birds with several more or less complete sets of plumage, but egg production virtually

implies continual reproduction, for the ultimate constituents of the egg are, with the exception of the amount obtained from the air, all that are combined in the living chick.

The body of a Leghorn pullet, about nine months old, in active laying, contains about 56 per cent of water, 21 per cent of different nitrogenous constituents, 18 per cent of fat, 3 per cent of ash or mineral matter, and 2 per cent of other substances. Leghorn hens almost two years old and laying showed an average composition of 55.7 per cent water, 21.6 per cent nitrogenous matter, 17.0 per cent fat, 3.8 per cent ash constituents, and 1.7 per cent other substances. There was found in the body of a mature capon about 41.6 per cent of water, 19.4 per cent nitrogenous matter, 33.9 per cent fat, 3.7 per cent ash, and 1.4 per cent other substances.

Notwithstanding the fact that the problem of poultry feeding is much more complex than that of feeding most other farm stock, fewer carefully collected data are available in formulating feeding standards for poultry than for cattle. The following rations for laying hens are, however, near the average of those that have given best results. They are stated at the rate per 1000 lbs. live weight, to compare with the standards which have been used in feeding other animals.

One thousand pounds live weight of laying hens, of about three pounds average weight, require from 65 to 100 pounds of total food, less bulky than that for the cow, or 55 pounds or more of water-free food per day, containing about 10 pounds digestible protein, 35 pounds digestible nitrogen-free extract and fiber, and 4 pounds of fat. From this ration the hens would produce generally from 15 to 30 pounds of eggs containing from 5 to 10 lbs. dry matter, one pound of eggs being produced from about 3 lbs. water-free food, one pound of dry matter of eggs for each 9 lbs. water-free food.

For one thousand pounds live weight of hens of about six pounds average weight, there should be fed from 50 to 80 lbs. of food per day, containing about 40 pounds of water-free food. There should be in this about 6 pounds of digestible protein, 23 pounds of digestible nitrogen-free extract and fiber, and 2 pounds of digestible fat.

The amount of food required per day per hen varies according to the size and somewhat with the season. A smaller hen will eat more in proportion to live weight than a larger one. The difference in amount of food consumed by larger and smaller hens is less when laying than at other times when enough for maintenance only need be eaten.

A Cochin or Brahma hen when laying requires from 4½ to 8 ounces of food per day, of which 3½ ounces or more is dry matter. A hen of Leghorn size when laying requires from 3½ to 6 ounces of total food, or 3 ounces of water-free food per day.

A much larger amount of food in proportion to the live weight is required by the chicks than by the older fowls. The amount of water-free food required for every one hundred pounds live weight fed is 10.6 lbs. at about one pound average weight; at two pounds 7.5 lbs.; at three pounds 6.4 lbs.; at four pounds 5.5 lbs.; at five pounds 5.3 lbs.; at six pounds 4.9 lbs.; at seven pounds 4.7 lbs.; at eight pounds 4 lbs.; at nine pounds 3.3 lbs.; at ten pounds average live weight 3.2 lbs. The amounts of fresh food equivalent to these weights would be correspondingly greater. These are the amounts taken by growing fowls which normally attain to the higher weights given, and which are still immature and growing rapidly when at five and six pounds average weight.

For young chicks the nutritive ratio of the ration fed can be somewhat narrower than those given for laying hens, and for fattening the ration can have a very much wider ratio, although only for short periods.

For one hundred hens about 16 quarts of clean water per day is required, especially in dry hot weather. In each dozen eggs there is about a pint of water.

A variety of food is essential.

Young hens, especially of the better laying breeds, when in full laying, can be freely fed all they will readily eat, but older hens and the young ones when not laying should be fed only enough to keep them eager for food. Salt should be fed mixed with the food, but not large coarse crystals. One ounce of salt per day for one hundred hens is a good proportion.

Animal food and green or succulent vegetable food, as well

as grain, should always be fed to hens that are confined. It is very important that ducks should have these foods, especially growing ducklings.

Some form of grit should be liberally supplied.

A largely grain ration will not contain the lime required by laying hens, and oyster-shells or some other form of carbonate of lime will supply this deficiency.

A grass run is better than any substitute in summer, but no run should contain hens in such a number as to kill the grass.

Common fowls, especially laying hens, must be kept in moderately small flocks. Where large numbers are kept, they should be divided in small lots in separate pens and yards. Ten to twenty in a pen give better results than larger numbers, although flocks twice as large can be profitably managed by experienced poultrymen. The laying hens should be kept separated from those not laying.

Hens will not always moult early enough to resume laying before midwinter. Chicks should be hatched in March and April if eggs are to be obtained from the pullets in November. Asiatics, to begin laying in the fall, should be hatched in February and March.

The best results in every respect cannot be secured where the average space of open run available per hen is much less than 100 square feet. The average floor-space per hen indoors should be about 10 square feet.

Exercise is of the utmost importance, especially for laying and breeding stock, and a good way to assure this in winter-time is to scatter the grain in straw or any clean and dry substitute.

Dampness is fatal, and dry warm houses free from draughts are essential in winter. The floors should be of dry earth or fine gravel, or wooden floors covered with straw or dry sand. The houses should be warm enough to prevent freezing of water, but should not be warmed by heating apparatus more than will insure against freezing.

LOSS IN WEIGHT OF EGGS DURING INCUBATION.

(STEWART AND ATWOOD.)

Directions for ascertaining the loss in weight of eggs during incubation.

After placing the eggs upon the trays ready for the incubator, set the trays upon a pair of scales reading to ounces and note the total weight of the eggs and trays. (The trays should be thoroughly dry.) After a few days weigh again. Subtract this from the first weight. This will give the actual loss in the weight of the eggs.

Example.—Suppose that you have 208 eggs on the trays; that the first weight with trays is 24 lb. 2 oz., and that on the sixth day the weight is 23 lb. 6 oz. Then the loss in weight is 12 ounces. Now look in the table for the loss in weight of 100 eggs for six days. This is 10 ounces. Ten ounces multiplied by 208 gives 20.8 ounces, which is the calculated loss for 208 eggs for six days. Therefore the eggs have not been losing weight as rapidly as they should, and the eggs should be given more ventilation or the incubator should be removed to a drier location. (It is assumed that the eggs are kept uniformly at the proper temperature.) After the eggs have been tested for the infertile ones, weigh again and proceed as before.

Rules.—If the eggs have lost too much weight, give more moisture, or less ventilation, but in reducing ventilation great care should be used, as pure air in the egg chamber is absolutely necessary. If the eggs have not lost enough weight, open the ventilators, or place the incubator in a drier place. The table shows normal loss in weight of 100 eggs in ounces for the first nineteen days of incubation.

Days.	*Loss in Oz.*	*Days.*	*Loss in Oz.*
1	1.65	11	18.60
2	3.31	12	20.33
3	4.96	13	22.10
4	6.62	14	23.88
5	8.28	15	25.66
6	10.00	16	27.44
7	11.72	17	29.21
8	13.44	18	30.99
9	15.16	19	32.77
10	16.88		

STANDARD WEIGHTS OF POULTRY.

(Am. Poultry Asso.)

	Cock.	Cockerel.	Hen.	Pullet.
A. *American Breeds.*				
Plymouth Rocks, Barred and Pea-combed Barred......lbs.	9.5	8	7.5	6.5
Plymouth Rocks, White.... "	9.5	8	7.5	6
Wyandottes, Silver, Golden, and White..................lbs.	8.5	7.5	6.5	5.5
Javas, Black.............. "	10	8.5	8.5	6.5
Javas, Mottled and White... "	10	8.5	8	6.5
American Dominiques...... "	8.5	7.5	6.5	5.5
Jersey Blues............... "	10	7	8	5
B. *Asiatic Breeds.*				
Brahmas, Light............ "	12	10	9.5	8
Brahmas, Dark............ "	11	9	8.5	7
Cochins, Buff, Partridge, White and Black................lbs.	11	9	8.5	7
Langshans............... "	9.5	8	7	6
C. *Other Breeds of Poultry.*				
Minorcas, Black and White..lbs.	8	6.5	6.5	5.5
Redcaps................. "	7.5	6	6.5	5
Houdans................. "	7	6	6	5
Crevecoeurs............... "	8	7	7	6
La Fleche................. "	8.5	7.5	7.5	6.5
Dorkings, White........... "	7.5	6.5	6	5
Dorkings Silver Gray...... "	8	7	6.5	5.5
Dorkings, Colored.......... "	9.5	8	7.5	6
Bantams, Game ....oz.	22	20	20	18
Bantams, Golden Sebright, Silver Sebright, Rose-combed White, Rose-combed Black, and Booted White........oz.	26	22	22	20
Bantams, Pekin or Cochin .. "	28	24	24	22
Bantams, Japanese and White-crested White............oz.	26	22	22	20
Russians..................lbs.	8.5	7.5	6.5	5.5
D. *Turkeys.*				
Bronze....................lbs.	35	24	20	15
Narragansett.............. "	32	22	22	14
Buff, Slate and Black....... "	27	18	18	12
White.................... "	26	16	16	10
E. *Ducks.*	Adult Drake.	Young Drake.	Adult Duck.	Young Duck.
Pekin and Cayuga ....lbs.	8	7	7	6
Aylesbury and Rouen...... "	9	8	8	7
Muscovy, Colored and White.. "	10	8	8	7
Crested White............. "	7	6	6	5
F. *Geese.*	Adult Gander.	Young Gander.	Adult Goose.	Young Goose.
Toulouse and Embden......lbs.	25	20	23	18
African.................. "	20	16	18	14
Chinese, Brown and White.. "	16	12	14	10
Canada.................. "	16	12	14	10

SYNOPSIS OF BREEDS OF POULTRY.

(M. LEMOINE.)

Breeds.	Eggs Laid per Annum.	Weight per Dozen Eggs.	Live Weight of Hens.	Weight of Meat at 6 Months.		Weight of Bones and Offal.		Food Consumed Daily.
		oz.	lbs.	lb.	oz.	lb.	oz.	oz.
Andalusian	150	29¼	5– 6	3	1	2	15	6¾
Brahma (light)	120	28½	8–10	4	11	5	0	9½
Cochin (buff)	115	24	8–10	4	9	5	4¾	17½
Creve Cœur	122	33	8– 9	4	9⅛	4	14¼	7⅛
Dorking (silver gray)	130	27½	7–10	5	4½	4	14	6¾
" (dark)	130	27½	6– 9	5	4	3	12	6½
Game	100	24	5– 6	3	15½	2	7¾	4½
Hamburgs (silver spangled)	239	20¼	4– 5	2	3½	2	7¾	4¼
" (golden pencilled)	225	19½	3½–4	1	15¾	2	7½	4¼
Houdan	125	26	6– 7	3	7	2	10¼	6¾
La Flêche	140	29½	6– 7	3	5¾	2	9¾	6¾
Langshan	115	27	7–10	4	14¾	5	1¼	7⅛
Leghorn (brown)	190	22	5– 6	3	15½	2	10¼	4¾
Minorca (black)	180	28½	5½–7					
Plymouth Rock	120	27½	6– 7½					
Scotch Gray	140	29	6	3	4½	2	12	6¾
Wyandottes	140	25	5½–7					

HEREDITY.

By Prof. THOS. SHAW, formerly of Minnesota Experiment Station.

Heredity in breeding relates to transmission. It is doubtless governed by fixed laws, but many of these are as yet imperfectly understood. It may be defined as the outcome of the operation of that law whereby properties and qualities of like kind with those of the parents are transmitted to the offspring. This transmission is certainly comprehensive in its character, since it relates to structure, function and qualities, and indeed to every feature of the organization. But in instances not a few there are apparent exceptions to this law of transmission. These, however, are apparent rather than real. They appear to us as exceptions because of the limitations of our knowledge of this great question. These supposed exceptions are doubtless the result of the predominant influence of other laws acting in opposition to the hereditary tendency, and it is characterized as normal, abnormal and acquired, according to its nature.

The heredity of normal characters means the transmission of those characters which are natural to the type. These may be original traits bestowed upon the species, as for instance, timidity in sheep; or they may have been acquired and rendered permanent by long-continued transmission, as in the changed form of all the improved breeds of domestic animals. The heredity of abnormal characters means the transmission of irregular characters, or those which have deviated from the natural and acquired characteristics of the type. These abnormal characters may appear as malformations of structure, derangement of function, or they may assume one or the other of various forms of disease. Illustrations of the first are found in certain families with an irregular number of fingers and toes; of the second in the inheritance of deafness, dumbness and impaired vision; and of the third, in the reappearance in the offspring of certain diseases possessed by the parents, as, for instance, any of the forms of scrofula.

The laws which govern heredity are those also which determine the results in practical breeding. In practice the rules which govern it are almost entirely empirical in their origin, since they have been almost exclusively derived from the accepted methods of the most successful breeders. Those who have given thought to the question will concede that breeding live-stock is at once a science and an art. They will see in it a *science* in so far as it discovers and systematically arranges those truths and principles which relate to the improvement of live-stock, and it will appear to them an *art* in so far as they perceive that those principles can be successfully utilized in practice. It is apparent therefore that the relation between the science and the art of breeding is both close and intimate. Without some knowlege of the former the latter is not likely to be successfully practised, and the measure of success which attends the efforts of the breeder will be largely proportionate to the measure of the knowledge which he may possess of the principles of heredity.

Reference has been made to certain laws which govern transmission. Of these three may be considered as funda-

mental, viz.: *first*, the law that "like begets like"; *second*, the law or principle of variation; and *third*, the law or principle known as atavism. Since these laws or principles appear to us to lack uniformity and regularity of action, the art of breeding is in consequence much more complicated and uncertain than it would otherwise be. This want of uniformity and of regularity of action, however, is apparent rather than real. But so long as we are ignorant of the cause or causes of these apparent irregularities in transmission, we are unable to prevent them. And yet there is so much of uniformity in the action of these laws that the intelligent breeder cannot be said to play at a game of chance. If well posted in the art, his efforts will in the main be entirely successful.

The law that "*like begets like*" implies that the characteristics of the parents will appear in their offspring. This law would seem to pervade all animated nature; generally speaking it is uniform in its action, but there are some exceptions. Were it not so, examples to illustrate such a law of heredity and proofs to support it would not have been needed. That the existence of this law was recognized, and that many of its principles were well understood from an early period, finds ample illustration in the breeding operations conducted by the patriarch Jacob, in the monstrous forms that were bred for the amusement of the Romans when the decline of the empire was pending, and in the care with which the Arabs kept their pedigrees from a remote antiquity.

So uniform is this principle of heredity in its action that it may be designated the compass which guides the breeder into the harbor of success. But before he can anchor there he must give attention to certain principles, a close adherence to which is absolutely essential to higher attainment in results. He must, for instance, breed to a standard of excellence; he must set a proper value on improved blood; and he must understand the art of selection and the principles of good management generally. Without a standard of excellence in his mind, that is, without an ideal type, the breeder does not himself know what he is seeking.

Without dominant or stable characters, in at least one parent, no stability in transmission can be looked for, and without purity of breeding for generations dominant characters cannot be secured. Hence the great importance of purity of blood in effecting improvement in domestic animals. Since some inferior animals will occasionally appear, even where the breeding is the most skilful, the necessity will always exist for the exercise of a most rigorous selection on the part of every breeder who is to stand on the upland of success. When aided by judicious selection, the law that like produces like enables us to effect improvement until a certain standard of excellence is reached, to maintain improvement when it has been secured, and to mould new types and form new breeds.

By the *law* or *principle of variation* is meant the tendency sometimes found in animals to produce characters in the progeny which differ from those of the parental type. These changes relate to both form and function; in time they may become modifications of the systems of animals. They may be classed as *gradual*, or *general* and *ordinary*; and as *sudden*, or *spontaneous* and *extraordinary*. *General variation* is that tendency to change from the original type which characterizes in a greater or a less degree all the individuals of a breed. Illustrations of the principle of general variation may be found, *first*, in the tendency of grain to deteriorate which has fallen upon an unkindly soil; and *second*, in the quick deterioration of the heavy breeds of sheep when confined to unproductive and rugged pastures. Chief among the numerous causes leading to general variation are changed conditions of life in animals, as climate, food, habit, and environment. Sometimes these influences act independently and sometimes in conjunction. The principle of *spontaneous variation* may be defined as that tendency sometimes found in animals to produce progeny more or less unlike either of the parents or the ancestry of these. Illustrations of the operation of this principle may be found in the occasional production of progeny very unlike the parents or the ancestry in color, form, and other characteristics, and in the existence of hornless breeds of cattle.

By *atavism* is meant that innate tendency in animals to revert to the original type. It differs from the principle that like produces like in the reproduction of resemblances to an ancestry more or less remote rather than to the parents, and differs from spontaneous variation in producing resemblances to an ancestry more remote than the immediate parents, whereas the latter produces characters unlike those of the ancestry, whether near or remote. Illustrations of atavic transmission are found in the occasional apearance of scars or horns in the polled breeds of cattle bred pure for many successive generations, and in the occasional appearance of tan-colored spots on the ears and face of the American merino.

It is evident, therefore, that an intimate knowledge of the principles which govern breeding is highly important to those engaged in the production of live-stock. Hence they should study these with the utmost care and should embody them in their practice to the greatest possible extent.

III. VETERINARY SCIENCE.

COMMON DISEASES OF FARM ANIMALS.

By W. G. Clark, M.D.C., Marinette, Wis.

I. HORSES.

The common method of administering medicine to the horse is in the form of a drench. In drenching a horse the bottle should be clean, strong, and smooth. The head should be elevated just enough to prevent the horse from throwing the liquid from the mouth. If the animal refuses to swallow, tickle the roof of the mouth with the finger or the neck of the bottle. Do not rub, pinch, or pound the throat, nor draw the tongue out. These in no way aid the horse to swallow and often do harm. If coughing occurs or by any mishap the bottle is crushed in the mouth, lower the head at once. Do not attempt to pour medicine through the nose; it is liable to strangle the animal.

Irritating substances, as turpentine, should be given in bland fluids such as oil or milk.

Warm-water injections are of great value in treating many bowel troubles. A very good injection pipe may be made with about 30 inches of inch rubber hose and an ordinary tin funnel. Oil the hose and insert it in the rectum from 12 to 18 inches, and elevate the funnel above the back and pour in the water. The force of gravitation will carry it into the bowels.

Soap and water, or salt and water, may be injected in this manner in quantitities of a gallon or more every hour.

Spasmodic Colic.

Causes.—Error in diet is the most prolific cause, as improper food in improper quantities at irregular intervals; large draughts of cold water when warm; eating when exhausted; intestinal parasites; or foreign bodies in the bowels.

Symptoms.—The horse manifests uneasiness, moves forward and back in the stall, looks toward the flank, switches the tail, paws, lies down and rolls; after a little the spasm will subside and the animal become quiet. Soon the spasm returns with

increased severity. As the disease progresses, the animal will become more violent and the intervals between the spasms shorter.

TREATMENT.—Always urgent, as it often runs a rapid course, terminating fatally in a few hours.

Give as a drench laudanum 1 oz., baking-soda one tablespoonful, sweet spts. nitre 1 oz., water one half-pint. This may be repeated in half an hour if not relieved. Always give injections of soap and warm water. Blanket the animal and rub the abdomen briskly. If inclined to hang on, apply a paste of mustard to the abdomen and give raw linseed oil 1 pt., chloral hydrate 4 dr., dissolved in warm water.

Flatulent Colic.

The causes and symptoms are similar to those of spasmodic colic.

The pain is not so severe at the outset and gradually increases in severity as the bowels become distended by gas. No intervals of ease as in spasmodic colic. The abdomen becomes rapidly distended and the animal dies from suffocation or rupture of the bowels unless soon relieved.

TREATMENT.—Usually necessary to puncture with a trocar and canula, which requires a knowledge of the anatomy of the parts. Internally give hyposulfite of soda 2 oz., fl. ex. ginger 4 dr., spts. turpentine 4 dr., water 1 pint. Repeat in half an hour if necessary. Give injection of soap and warm water at short intervals.

Pneumonia—Lung Fever.

The most common cause is exposure to a cold draught when tired and sweaty.

SYMPTOMS.—It is usually ushered in with a chill, followed by fever. The ears and legs are cold, pulse-rate increased, labored breathing, elbows turned out, increased working of the ribs, the animal persistently stands, appetite usually lost.

TREATMENT.—Place in a comfortable well-ventilated box-stall. Blanket warmly, rub the legs and apply bandages.

During the chill give large doses of stimulants, as whisky, alcohol, ginger, etc., at short intervals.

If the breathing is not relieved in a few hours, apply mustard over the ribs, just back of the shoulder-blades.

Give nourishing, easily digested food. Keep the animal perfectly quiet. Give ½-oz. doses of nitrate of potash in the drinking-water three times daily. After the chill is relieved keep a pail of fresh water before the animal at all times.

Azoturia—Black-water.

This disease is quite common among farm horses, and is due solely to overfeeding on nitrogenous foods and lack of exercise, followed by the accumulation in the system of waste matters.

Symptoms.—The animal is taken from the barn after a few days' rest on full rations, apparently as well as usual. After driving from half a mile to six or eight miles the horse will begin to lag and sweat profusely. Shortly will begin to go lame, usually in one hind limb. If urged on, will soon lose the use of the limbs and fall to the ground, unable to rise. The urine if passed will be dark and coffee-colored. This is a diagnostic symptom. The muscles over the hips become hard and swollen, and the animal will struggle convulsively and attempt to rise.

Treatment.—Unhitch the animal as soon as the first symptoms are noticed and take the horse to the nearest barn. Fold a woolen blanket and wring out of hot water and place over the hips, covering with a dry blanket. Repeat as soon as it becomes cool, and continue this until the more acute symptoms are relieved. Internally give laudanum 1 oz., raw linseed oil one pint, and repeat the laudanum in an hour if the pain is not relieved. If possible, the urine should be drawn with a catheter, as it is rarely passed when the animal is down. Give injections of soapy warm water at frequent intervals.

Distemper—Strangles.

This is a contagious disease due to a specific virus that very few horses escape. It usually runs a benign course and terminates favorably.

Foot-Rot.

Separate the sound animals from the diseased ones and from contaminated pastures and buildings. Carefully remove all diseased horn and foreign bodies and walk the sheep through a trough containing one pound of blue vitriol to three gallons of water. Place the infected flock on a dry upland pasture, if possible.

Grub in the Head.

This is the larvæ of a small gadfly (*vestrus ovis*) which deposits its eggs within the nostrils. It stays there during the winter and spring, often proving harmless, but sometimes causing much irritation, a white muco-purulent discharge, with dullness and stupor.

PREVENTION.—Smear the nose with tar, or feed salt from two-inch augur-holes bored in a log, the surface of which is smeared with tar.

TREATMENT.—Place in a warm building and introduce into the nostrils snuff, a solution of tobacco, or turpentine and olive-oil equal parts, to kill the larvæ or cause their expulsion by sneezing; or place in a close room and subject to the fumes of burning sulphur for 15 min., as strong as can be endured, once daily for 3 or 4 days.

IV. SWINE.

Hog Cholera.

A specific contagious fever of swine.

SYMPTOMS.—The period of incubation varies from three to fifteen days. Shivering, nose hot and dry, later refuses food, lies under the litter, eyes sunken, gait unsteady. Heat and soreness of the skin, with tenderness, red patches and black spots; labored breathing; hard, dry cough; soreness of the belly; costiveness, followed by a fœtid diarrhoea.

PREVENTION.—If it breaks out in a herd, kill and bury the diseased. Thoroughly disinfect everything they have come in contact with, using one-half ounce of corrosive sublimate in four gallons of water. Burn all straw and litter. Give the healthy ones clean, dry quarters. If possible, divide up the herd, placing a few in each pen. Allow free access to

wood or animal charcoal and give in the drinking-water ten drops of carbolic acid for each one hundred and fifty pounds of live weight. Take the temperature daily, inserting a clinical thermometer in the rectum, and remove every animal showing a temperature of 103° or over.

Kill and bury as soon as the symptoms of the disease are well manifested.

Medicinal treatment of the disease is of but little avail. A good dietetical treatment, including a strict observance of sanitary principles, is of much more importance than the use of medicines.

The pens should be kept scrupulously clean. The food given should be clean, of the best quality, and easily digested. The troughs used in feeding should be thoroughly cleaned at least once daily. Keep away from infected herds, as the germs may be carried on the shoes or clothing. It is said that the virus will blow half a mile on the wind. It may also be spread by birds and dogs.

Intestinal Worms.

This is one of the most common troubles of swine.

SYMPTOMS.—A cough is usually the first symptom noticed; animals have a voracious appetite, yet lose flesh and exhibit general signs of ill health. If the fæces are examined the worms or their eggs can usually be found.

TREATMENT.—Give one teaspoonful of spirits of turpentine for each one hundred and fifty pounds of live weight once daily in milk or oil. Place common salt where they can have free access to it. Give nutritious, easily digested food.

VETERINARY REMEDIES AND DOSES.

By W. G. CLARK, M.D.C., Marinette, Wis.

Graduation of Doses.

Horse.	Ox.	Dose.
3 years.	2 years.	1 part.
2 "	1 "	2/3 "
1 "	9 months.	1/3 "
6 months.	3–6 "	1/8 "
1–6 "	1–3 "	1/16—1/32 part.

When not specified, the doses given apply to a full-grown horse of medium size. Dose for the ox, from 1½ to 2 parts; sheep, ⅛ to ¼ part. Animals of a nervous temperament are usually more susceptible to the action of drugs.

No agent should be given until sufficiently diluted to prevent irritation of the mouth, and irritants that will not mix with water (turpentine, etc.) should be given in linseed oil, milk, or eggs, after being thoroughly mixed.

RAW LINSEED OIL.—Dose: Horse, one half-pint to one quart. Laxative in small doses, purgative in large. Not so active as castor oil. A valuable laxative in young and delicate animals. For calves and lambs it is more gentle and safer than salts. In adults it is the best laxative to use where there is an irritable condition of the bowels, and in all febrile diseases where a laxative is needed. In impaction of the bowels a pint may be given two or three times daily until relieved, supplemented by warm-water injections every two hours. Valuable in cases of choking on account of its lubricating qualities.

CASTOR OIL.—Causes more griping and nausea than linseed oil and is more certain in its action. Used chiefly as a laxative for calves, foals, sheep, swine, and dogs.

Useful in diarrhœa of calves and other young animals when the discharges are bright yellow and irritating. Dose for a calf, from 1 to 4 tablespoonfuls.

EPSOM SALTS.—For cattle this is the purgative in most frequent and general use. Adult cattle take from 1 lb. to 1½ lbs. In small doses in febrile diseases it lowers the temperature, improves the appetite, and helps to maintain a healthy and regular action of the bowels. Epsom salts is one of the best antidotes for lead poisoning. When used as a purgative, give from 1 to 2 oz. ginger with the salts.

OIL OF TURPENTINE (SPTS. TURPENTINE).—Dose: Horse, ½ to 1 oz. Very irritating to the mucous membrane, and when used internally should be given in oil or some bland fluid. Stimulant and anti-spasmodic. One of the most useful remedies in flatulent colic in the horse, and hoven or bloat in the ox. Also used to kill and expel intestinal worms. When used for this purpose, it is given after fasting in

large doses, 1½ to 2 oz. for the horse, followed in 12 hours by a purgative.

Applied externally it is an irritant and is used in many liniments. The following liniment may be used where a mild counter-irritant is desired: Oil of turpentine and aqua ammonia, of each 4 oz., linseed oil 8 oz. Mix. This liniment is used chiefly for rheumatic swellings, sprains, and bruises after the active pain is subdued by fomentations, and for sore throats, as seen in distemper.

ALCOHOL.—Dose: Horse, ½ oz. well diluted, whisky or brandy 2 to 4 oz. Alcohol is a narcotic poison. It first stimulates, then deranges, and ultimately depresses the functions of the brain and spinal cord. It kills, as a rule, by paralysis of respiration. Medicinally it is a very valuable, diffusible stimulant, anti-spasmodic heart tonic and antiseptic. Moderate doses increase the gastric secretions and aid digestion, but large doses destroy pepsin, arrest secretion, and interfere with absorption. There is probably no drug more extensively used than alcohol. It is useful in indigestion, spasmodic colic, cases of poisoning by aconite or tobacco. It is valuable in influenza and debilitating diseases. In blood-poisoning whisky combined with quinine is one of the most effective agents we have in controlling the temperature and keeping up the strength of the animal.

The following is very useful in some cases of indigestion: Whisky 1 pt., quinine (sulfate) 1 oz., water 1 pt. Mix. Give 3 ounces at intervals of 3 to 4 or 6 hours, according to the nature of the case.

SALTPETER (NITRATE OF POTASH).—Dose: Horse, 1 teaspoonful to half an ounce. Large doses are irritant and cathartic and are liable to cause inflammation of the bowels. Medicinal doses are discretive, alterative, antiseptic, febrifugal, and refrigerant. In febrile, inflammatory, and rheumatic complaints it allays fever, lowers excessive temperature, and removes by the kidneys both solid and fluid matters. Dissolved in water and applied externally it abstracts heat and is a useful refrigerant. Combined with sulfate of iron it makes an excellent tonic for horses recovering from debilitating diseases.

Saltpeter 2 oz., dried sulf. iron 3 oz. Mix. Give 2 teaspoonfuls with the feed 2 or 3 times daily.

ALUM.—Alum is an astringent. Chiefly used externally. Use a saturated solution in hot water. Applied to the shoulders of horses in the spring it toughens the skin and prevents collar-galls. Useful in healing harness-galls. One of the best lotions to apply to barb-wire cuts and other wounds of a similar nature to prevent growth of proud flesh. Sometimes dusted over the surface in the form of burnt alum; not so effective as the saturated solution.

GINGER.—Dose: Horse, ½ to 1 oz. Ginger stimulates the various mucous membranes with which it comes in contact. Administered internally it increases the gastric secretions, facilitates digestion, and checks formation of gas. It is a useful adjunct to many medicines and is given with tonics and stimulants. Combined with purgatives it diminishes their liability to nauseate and gripe, and also hastens their effect. It is used in all domesticated animals to fulfil those purposes, and is especially adapted to cattle and sheep.

CARBOLIC ACID.—One of the best and cheapest disinfectants known. For dressing fresh wounds it may be used in from 2 per cent to 5 per cent watery solution. In oil 1 part to 15. Inhalation of the vapor with steam is of great service in malignant sore throat and abscesses following strangles. Carbolic acid is a narcotic irritant poison, and considerable care must be exercised in its use, as it is liable to become absorbed and produce poisonous effects if applied over a large surface in a strong solution. It has been highly recommended in the treatment of hog cholera. It may be given to hogs in doses of from 1 to 5 drops well diluted.

PINE TAR.—Not much employed internally. It is a good dressing in thrush and canker of the horse's foot. It is also of special service in foot-rot in sheep. It acts as a stimulant and deodorizer to foul-smelling wounds and prevents the attacks of flies.

LIME WATER.—Lime water is prepared by slaking a small quantity of freshly burned lime with a large quantity of

water, allowing the undissolved matter to settle and pouring off the clear solution. This should be kept in tightly corked bottles. Lime water is an alkali and is used in indigestion, bloat, and diarrhœa, especially among calves. Given with the milk in the proportion of 1:5. Scalds and burns may be treated with carron oil, which is composed of lime water and linseed oil, equal parts. Fresh lime in powder and solution is used in cleansing and disinfecting stables. For this purpose a little carbolic acid may be added to the solution.

SULFUR.—In large doses it is an active irritant poison. In medicinal doses it is a laxative, alterative, and stimulates secretion. Care should be taken to prevent the animal from taking cold when given sulfur. It opens the pores of the skin and stimulates perspiration. Chiefly used in treating rheumatism and chronic skin diseases. Dose: Horse, ½ oz. to 2 oz.

SUPPRESSION OF HOG CHOLERA AND SWINE PLAGUE. (CRAIG.)

CAUSES.—Hog cholera and swine plague are caused by different bacteria, but they are equally dependent for the success of their attacks on the unhealthiness of the hogs, due in most instances to unwholesome food and filthy surroundings. The causes are so similar and the symptoms are so much alike and often complicated that it will be best to consider the diseases together in what follows. The germs that cause them are easily spread over large territories by being carried by cars, wagons, or the shoes of persons that have been among infected hogs. Most frequently the origin of the outbreak may be traced to the importation of hogs from diseased districts or to spread from such centers by running streams.

SYMPTOMS.—The first symptoms usually shown in attacks of these diseases are those that indicate fever—a rise in temperature, thirst, loss of appetite, and redness of the skin on the lower part of the neck and inner side of the thigh. Usually a hog so diseased begins to cough when started

from its bed. A constipated condition of the bowels changes to diarrhœa as the disease progresses, and this results in a rapid loss of flesh. Dissection generally shows the lungs to be inflamed, the spleen enlarged, or the lining of the large intestine covered with numerous ulcers.

PREVENTION.—To protect hogs from attacks of these diseases it is necessary to observe the following recommendations: The hogs should not be watered at running streams, as the germs are readily carried by these. Persons coming from infected districts should not be allowed to go near your hogs, and you should not go among your neighbors' hogs if they are sick. When other hogs are brought to your farm, assume that they are infected and keep them away from yours at least for six weeks. Observe as much cleanliness as possible in regard to food and surroundings. Feed a mixture of foods in a sloppy or soft condition, and withhold heavy grain feeding. Disinfect the quarters of the hogs by sprinkling liberally with a five per cent solution (by volume) of carbolic acid, and use a two per cent solution of the same for washing the hogs.

TREATMENT.—The hogs showing any of the symptoms described should at once be separated from the others, and put in cheaply constructed quarters, so that the latter may be burned when no longer required. The well hogs should be removed to disinfected quarters. Give all the hogs the following mixture, recommended by Dr. Salmon, Chief of the Bureau of Animal Industry:

Wood charcoal	1 lb.
Sulfur	1 "
Salt	2 lbs.
Baking-soda	2 "
Glauber's salts	1 lb.
Sodium hyposulfite	2 lbs.
Antimony sulfid	1 lb.

This should be given in soft food in the proportion of a teaspoonful daily to a two hundred pound hog. Remove all refuse from the pens in which the infected hogs were kept, and dig out the old soil, put in fresh earth, disinfect

with carbolic acid solution, and allow the pens to remain vacant for at least six months. The same feeder should not attend the well and the sick hogs unless his shoes are changed after each visit to the sick hogs. The bodies of the dead hogs should be thrown into a rubbish heap and burned; but if this cannot be easily carried out, a long, deep trench should be dug, and when the carcases are thrown into it they should be covered with a layer of quicklime and at least six inches of earth. When the disease has spent itself or has been effaced, the entire mass in the trench should be covered with six inches of quicklime and at least six feet of earth. The place selected for the burial of the hogs should not drain towards a stream, and it would be better to fence it. The dead hogs should never be drawn over the ground, and the wagon used should be washed with a disinfectant.

During the last few years the *serum* treatment of swine plague and hog cholera has been introduced experimentally by the Bureau of Animal Industry of the U. S. Dept. of Agriculture. Although the results so far obtained are very promising, further studies are required before the efficacy and practicability of the method can be considered proved. Farmers whose hogs are attacked by hog cholera, or who fear such an attack, should at once communicate with the Bureau or with the State authorities and ascertain what assistance can be had.

DIRECTIONS FOR MAKING TUBERCULIN TESTS.

Animals must be kept in as nearly a normal condition as possible during the test. Before injection take four temperatures, about two hours apart. Inject in the evening at about nine o'clock; begin taking temperatures eight to ten hours after the injection and continue until at least five temperatures, two hours apart, have been taken. In case an animal shows an abnormally high temperature at the end of this period continue taking temperatures until a decided drop toward the normal is noted.

A rise of 2 to 2.5 deg. F. above the average normal body temperature, maintained for several hours, is considered a positive

reaction, especially when the maximum temperature goes above 104 deg. F.

Precaution.—Water before beginning the temperature readings the first day of the test; on the second day give a small quantity (a pailful or so) in barn, if necessary, and turn stock out in the afternoon for further watering. Large quantities of cold water reduce the temperature, and if animals are watered at the usual time in the morning on the day following the injection, marked errors may be caused in the test. (Wis. Exp. Station.)

LIST OF DISINFECTANTS.

(STERNBERG.)

The most useful agents for the destruction of spore-containing infectious material are:

1. *Fire.*—Complete destruction by burning.
2. *Steam under Pressure*, 105° C. (221° F.,) for ten minutes.
3. *Boiling in Water* for half an hour.
4. *Chlorid of Lime* (should contain at least 25 per cent of available chlorin).—A 4 per cent solution.
5. *Mercuric Chlorid.*—A solution of 1–500.

For the destruction of infectious material which owes its infecting power to the presence of micro-organisms not containing spores, any of the following agents are recommended:

1. *Fire.*—Complete destruction by burning.
2. *Boiling in water* for ten minutes.
3. *Dry Heat*, 110° C. (230° F.), for two hours.
4. *Chlorid of Lime.*—A 2 per cent solution.
5. *Solution of Chlorinated Soda* (should contain at least 3 per cent of available chlorin).—A 10 per cent solution.
6. *Mercuric Chlorid.*—A solution of 1–2000.
7. *Carbolic Acid.*—A 5 per cent solution.
8. *Sulfate of Copper.*—A 5 per cent solution.
9. *Chlorid of Zinc.*—A 10 per cent solution.
10. *Sulfur Dioxid* (this will require the combustion of between 3 and 4 lbs. of sulfur for every 1000 cubic feet of air-space).—Exposure for twelve hours to an atmosphere containing at least 4 volumes per cent of this gas, *in presence of moisture.*

RULES FOR DISINFECTION OF STABLES.

In Case of Appearance of Contagious Diseases.

(TRUMBOWER.)

1. Have all loose litter, hay, and rubbish removed and burned.

2. Have all manure removed to land where cattle have no access.

3. Have all feed-troughs, hay-racks and all woodwork thoroughly cleaned by washing with hot water in which two ounces of carbolic acid to each gallon of water are dissolved.

4. Thoroughly whitewash the whole of the interior of the building with a whitewash containing one pound of chloride of lime to each four gallons of water. Enough freshly burned quicklime should be added to make the wash show where applied. Especially should this be applied to the sides and front of the stalls, feed-troughs and hay-racks (inside and outside).

5. All rotten woodwork to be removed and burned, and replaced with new.

6. All buckets, forks, shovels, brooms, and other objects used about the stable to be washed and covered with the same solution.

7. All drains to be thoroughly cleaned and disinfected with a solution of chloride of lime, one pound to four gallons of water.

8. In cases of glanders, all harness, poles, and shafts of wagons, neck-yokes and pole-straps should be thoroughly washed with hot water and soap, and afterwards oiled with carbolized oil (one part of carbolic acid to ten of oil). Before applying the oil, harness should be hung up in the open air for one week.

REGULATIONS FOR THE GOVERNMENT OF Dairies and Dairy Farms in the District of Columbia.

SECTION 1.—No building shall be used for stabling cows for dairy purposes which is not well lighted, ventilated, drained, and constructed.

Sec. 2.—No building shall be used for stabling cows for dairy purposes which is not provided with a suitable floor, laid with proper grades and channels to immediately carry off all drainage; and if a public sewer abuts the premises upon which such building is situated, they shall be connected therewith whenever, in the opinion of the health officer, such sewer connection is necessary.

Sec. 3.—No building shall be used for stabling cows for dairy purposes which is not provided with good and sufficient feeding-troughs or boxes, and with a covered water-tight receptacle, outside of the building, for the reception of dung and other refuse.

Sec. 4.—No water closet, privy, cesspool, urinal, inhabited room, or workshop shall be located within any building or shed used for stabling cows for dairy purposes, or for the storage of milk or cream, nor shall any fowl, hog, horse, sheep, or goat be kept in any room used for such purposes.

Sec. 5.—The space in buildings or sheds used for stabling cows shall not be less than five hundred cubic feet for each cow, and the stalls therefor shall not be less than four feet in width.

Sec. 6.—It shall be the duty of each person using any premises for keeping cows for dairy purposes to keep such premises thoroughly clean and in good repair and well painted or whitewashed at all times.

Sec. 7.—It shall be the duty of each person using any premises for keeping cows for dairy purposes to cause the building in which cows are kept to be thoroughly cleaned, and remove all dung from the premises so as to prevent its accumulation in great quantities.

Sec. 8.—It shall be the duty of any person having charge or control of any premises upon which cows are kept to notify the health officer, in writing, of the existence of any contagious or infectious disease among such cows, within twenty-four hours of the discovery thereof, and to thoroughly isolate any cow or cows affected or which may reasonably be believed to be infected, and to exercise such

other precautions as may be directed, in writing, by the health officer.

SEC. 9.—Any person using any premises for keeping cows for dairy purposes shall provide and use a sufficient number of receptacles made of non-absorbent materials, for the reception, storage, and delivery of milk, and shall cause them at all times to be cleansed and purified, and shall cause all milk to be removed without delay from the rooms in which the cows are kept.

SEC. 10.—Every person keeping cows for the production of milk for sale shall cause every such cow to be cleaned every day and to be properly fed and watered.

SEC. 11.—Every person using any premises for keeping cows shall cause the yard used in connection therewith to be provided with a proper receptacle for drinking water for such cows; none but fresh, clean water to be used in such receptacle.

SEC. 12.—Any enclosure in which cows are kept shall be graded and drained so as to keep the surface reasonably dry and to prevent the accumulation of water therein, except as may be permitted for the purpose of supplying drinking water; no garbage, urine, fecal matter, or similar substances shall be placed or allowed to remain in such enclosure, and no open drain shall be allowed to run through it.

SEC. 13.—These regulations shall apply to all premises upon which cow's milk is produced for sale.

SEC. 14.—That any person violating any of these regulations shall, on conviction in the police court of said district, be punished by a fine of not less than five nor more than ten dollars for each and every offense, to be collected as other fines and penalties are collected.

(See also p. 272, Rules and Regulations to be observed in the care of cows and the handling of milk shipped to the City of New York.)

IV. FIELD CROPS.

QUANTITY OF SEED REQUIRED TO THE ACRE.

(WARING.)

Designation.	Quantity of Seed.	Designation.	Quantity of Seed.
Wheat..........	1½ to 2 bu.	Broom-corn....	1 to 1½ bu.
Barley	1½ to 2½ bu.	Potatoes........	5 to 10 bu.
Oats	2 to 4 bu.	Timothy........	12 to 24 qts.
Rye.............	1 to 2 bu.	Mustard........	8 to 20 qts.
Buckwheat......	¾ to 1½ bu.	Herd grass.....	12 to 16 qts.
Millet...........	1 to 1½ bu.	Flat turnip......	2 to 3 lbs.
Corn............	½ to 1 bu.	Red clover......	10 to 16 lbs.
Beans..........	1 to 2 bu.	White clover....	3 to 4 lbs.
Peas	2½ to 3½ bu.	Blue grass......	10 to 15 lbs.
Hemp..........	1 to 1½ bu.	Orchard grass...	20 to 30 lbs.
Flax............	½ to 2 bu.	Carrots.........	4 to 5 lbs.
Rice	2 to 2½ bu.	Parsnips.......	6 to 8 lbs.

When planted in rows or drills:

Broom-corn.....	1 to 1½ bu.	Onions..........	4 to 5 lbs.
Beans...	1½ to 2 bu.	Carrots..........	2 to 2½ lbs.
Peas....	1½ to 2 bu.	Parsnips........	4 to 5 lbs.
		Beets...........	4 to 6 lbs.

SEED USED PER ACRE. (McKERROW.)

	Drilled, Bus.	Broad-cast, Bus.		Drilled, Lbs.	Broad-cast, Lbs.
Wheat....	1½	2	Clover (red)........	....	12
Oats................	2	2½	Clover (Alsike).....	....	4
Barley.....	1¾	2¼	Clover (white)	. .....	3
Rye................	2	2½	Clover & timothy { 8 clover, 2 timothy }	......	10
Peas...............	2	....			
Buckwheat...	....	½	Timothy..........	.. .. ..	5
Beans..............	1½	....	Orchard-grass......	....	25
Oats & peas, mixed for hay { Oats	1	....	Rape..............	1½	3
Oats & peas, mixed for hay { Peas	2	....	Turnips	1	2
Flax...............	....	½ to 1½	Carrots..	2	....
Millet.............	....	1	Beets.............	4	....
Corn...............	¼	....	Sugar Beets........	20	....
Potatoes....	10	....			

SEED MIXTURES FOR HAY AND PERMANENT PASTURES

In Pounds per acre.

Names of Grasses.	I. Flint.	II. Lawson.	III. For Good Medium Soils. De Launé	IV. For Wet Soils. De Launé	V. For Chalky Soils. De Launé	VI. For Permanent Lawns. Flint.
Meadow foxtail	2	2	10	4	...	3
Orchard grass	6	4	...	...	...	3
Sweet-scented vernal	1	...	...	...	...	2
Meadow fescue	2	2	6	3	2	2
Tall fescue	...	2	3	8	...	2
Hard fescue	...	2	1	1	4	2
Sheep's fescue	...	...	1	...	4	2
Redtop	2	2	...	...	...	3
June grass	...	2	...	...	...	4
Kentucky blue grass	4	...	...	...	...	...
Italian rye grass	4	6	...	...	...	3
Perennial rye grass	6	8	...	...	...	4
Timothy	3	3	3	3	...	3
Rough meadow grass	2	2	1½	2	...	3
Wood meadow grass	...	2	...	...	...	...
Red clover	...	...	...	...	...	2
Perennial red clover	3	2	1	1	1	2
White (Dutch) clover	5	5	1	1	1	2
Alsike	...	...	1	1	1	...
Yellow oat grass	...	1	...	...	1	1
Cock's-foot	...	...	7	10	14	...
Crested dog's-tail	...	...	2	2	5	...
Fiorin	...	...	1½	2	...	...
Yarrow	...	...	1	1	2	...
Cat's-tail	...	...	...	...	3	...
Cow grass	...	...	1	1	...	...
	40	45	41	40	38	43

For the Northwest the following mixture will, according to Shaw, be found suitable:

Timothy 4 lbs., blue grass 3 lbs., redtop 2 lbs., orchard grass 2 lbs., meadow fescue 1 lb., tall oat grass 1 lb., meadow foxtail 1 lb., alsike clover 3 lbs., white clover 2 lbs., lucern (alfalfa) 2 lbs., yellow clover 1 lb., total 22 lbs.

And for the States east of Michigan and for the provinces of Canada eastward of Lake Huron:

Lucern (alfalfa) 5 lbs., orchard-grass 4 lbs., meadow fescue and alsike clover 3 lbs. each, tall oat grass, timothy, meadow foxtail, and white clover 2 lbs. each, yellow clover 1 lb.; total 24 lbs.

The following mixtures of seeds are suggested for meadows and for pastures by the U. S. Department of Agriculture:

A. Hay Mixtures.

No. 1.

	Pounds.
Tall oat grass	70
Red clover	30

(Sow 35 to 40 lbs. per acre.)

No. 2.

Red top	30
Orchard grass	40
Meadow fescue	20
Red clover	10

(Sow 40 to 45 lbs. per acre.)

No. 3.

	Pounds.
Italian rye grass	20
Orchard grass	25
Red clover	10
Tall oat grass	20
Red top	25

(Sow 35 to 40 lbs. per acre.)

No. 4.

Timothy	40
Red top	40
Tall oat grass	20

(Sow 40 lbs. per acre.)

B. Pasture Mixtures.

No. 1.

Kentucky blue grass	25
White clover	10
Perennial rye	30
Red fescue	10
Red top	25

(Sow 35 lbs. per acre.)

No. 2.

Canada blue grass	5
Red clover	5
Orchard grass	5
Tall oat grass	5
Perennial rye grass	20
Red top	35

(Sow 40 to 45 lbs. per acre.)

No. 3. For wet pastures.

Red top	35
Alsike	20
Creeping bent	15
Perennial rye	30

(Sow 40 lbs. per acre.)

No. 4. For light sandy soils.

Red fescue	50
Red top	25
Kentucky blue grass	20
White clover	5

(Sow 35 to 40 lbs. per acre.)

IMPORTANT DATA AS TO FIELD CROPS.

(U. S. Department of Agriculture.)

A. *New England States.*

Kind of Crop.	Date of Planting.	Best Soil.	Amount of Manure per Acre.	Amount of Seed per Acre.	Wks. to Maturity.	Average Yield per Acre, Bushels.	Range of Price per Bushel.	Standard Varieties.
Indian corn...	May 10–30	Sandy or clay loam	8–12 tons	8–12 qts.	14–17	32–40	$0.50–.67	Leaming, Sanford, Flint
Wheat.......	Fall or spring	Clay loam	18 "	2 bu.	20	16–24	.77–.92	
Oats.........	Apr.–May	Strong loam	6– 8 "	2–3 "	11–15	31–38	.35–.38	White
Barley.......	Apr.–June 20	" "	7– 8 "	2–3 "	10–15	23–28	.52–.77	
Rye.........	Apr.–May, Sep.	Medium loam	7– 8 "	5–6 pecks	40	16–17	.65–.82	White
Buckwheat...	June 1–20	Light loam	4– 6 "	1–1¼ bu.	10–15	16–30	.40–.72	
White beans..	May–June	Sandy loam	7– 8 "	8–16 qts	8–14	16–20	1.75–2.50	
Potatoes.....	Apr. 15–May 1	Rich loam	15–20 "	8–20 bu	12–20	80–350	.30–1.25	Green Mountain, Carmon 3, Rose
Turnips......	July 1–Aug. 3	Sandy loam	10 "	1 lb.	10	200–500	.15–.35	Yellow
Mangels......	Apr. 15–May 5	Strong, heavy loam	8–15 "	4–6 lbs.	17–22	20–30*	3.00†	Long Red, Sugar
Tobacco......	Seed-bed, Apr.	Sandy loam	8–12 "	....	9–12	800–1800[1]	.05–.50[2]	

B. *Middle States.*

Kind of Crop.	Date of Planting.	Best Soil.	Amount of Manure per Acre.	Amount of Seed per Acre.	Wks. to Maturity.	Average Yield per Acre, Bushels.	Range of Price per Bushel.	Standard Varieties.
Indian corn...	Apr. 20–May 30	Medium loam	8–12 tons	6–8 qts.	16–18	24–33	.38–.47	Leaming, White Dent, Yellow Dent
Wheat.......	Sep. 20–Oct. 20	Loam	8 tons; 300 lbs. fert.	2 bu.	41–43	14–20	.70–.82	Fultz
Oats.........	Mar.–May	Moist clay loam	8 tons	2–2½ "	16–17	21–31	.30–.32	White, Black
Barley.......	" – "	Clay loam	8 "	-2½ "	13–16	19–27	.50	Manshury
Rye.........	Sept. 1–Oct. 1	Sand or gravel loam	8 "	1½ "	40–43	15–16	.53–.56	White Winter

* Tons. † Per ton. [1] Pounds. [2] Per pound.

THE WEIGHT AND AVERAGE COMPOSITION OF ORDINARY CROPS IN POUNDS PER ACRE.

(Warington.)

	Weight of Crop. At Harvest.	Weight of Crop. Dry.	Total Pure Ash.	Nitrogen.	Sulfur.	Potash.	Soda.	Lime.	Magnesia.	Phosphoric Acid.	Chlorin.	Silica.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Wheat:												
grain, 30 bu..	1,800	1,530	30	33	2.7	9.3	0 6	1.0	3.6	14.2	0.1	0.6
straw...... ..	3,158	2,653	142	15	5.1	19 5	2.0	8.2	3.5	6.9	2.4	96.3
Total crop..	4,958	4,183	172	48	7.8	28.8	2.6	9.2	7.1	21.1	2.5	96.9
Barley:												
grain, 40 bu..	2,080	1,747	46	35	2.9	9.8	1.1	1.2	4.0	16.0	0.5	11.8
straw....	2,447	2,080	111	13	3.2	25.9	3.9	8.0	2.9	4.7	3.6	56.8
Total crop..	4,527	3,827	157	48	6.1	35.7	5.0	9.2	6.9	20.7	4.1	68.6
Oats:												
grain, 45 bu..	1,890	1,625	51	38	3.2	9.1	0.8	1.8	3.6	13.0	0.5	19.9
straw....	2,835	2,353	140	17	4.8	37.0	4.6	9.8	5.1	6.4	6.1	65.4
Total crop..	4,725	3,978	191	55	8.0	46.1	5.4	11.6	8.7	19.4	6.6	85.3
Maize:												
grain, 30 bu..	1,680	1,500	22	28	1.8	6.5	0.2	0.5	3.4	10.0	0.2	0.5
stalks, etc....	2,208	1,877	99	15	....	29.8	...	.. .	.	8.0		
Total crop..	3,888	3,377	121	43	....	36.3	...	....	....	18.0		
Meadow hay, 1½ tons.	3,360	2,822	203	49	5.7	50.9	9.2	32.1	14.4	12.3	14.6	56.9
Red clover hay, 2 tons	4,480	3,763	258	102	9.4	83.4	5.1	90.1	28.2	24.9	9.8	7.0
Beans:												
grain, 30 bu..	1,920	1,613	58	77	4.4	24.3	0.6	2.9	4.2	22.8	1.1	0.4
straw...... ...	2,240	1,848	99	29	4.9	42.8	1.7	26.3	5.7	6.3	4.3	6.9
Total crop..	4,160	3,461	157	106	9.3	67.1	2.3	29.2	9.9	29.1	5.4	7.3
Turnips:												
root, 17 tons.	38,080	3,126	218	63	15.2	108.6	17.0	25.5	5.7	22.4	10.9	2.6
leaf..........	11,424	1,531	146	49	5.7	40.2	7.5	48.5	3.8	10.7	11.2	5.1
Total crop..	49,504	4,657	364	192	20.9	148.8	24.0	74.0	9.5	33.1	22.1	7.7
Swedes:												
root, 14 tons..	31,360	3,349	163	70	14.6	63.3	22.8	19.7	6.8	16.9	6.8	3.1
leaf..........	4,704	706	75	28	3.2	16.4	9.2	22.7	2.4	4.8	8.3	3.6
Total crop..	36,064	4,055	238	98	17.8*	79.7	32.0	42.4	9.2	21.7	15.1	[illegible].7

* Calculated from a single analysis only.

THE WEIGHT AND AVERAGE COMPOSITION OF ORDINARY CROPS.—*Continued.*

	Weight of Crop. At Harvest.	Weight of Crop. Dry.	Total Pure Ash.	Nitrogen.	Sulfur.	Potash.	Soda.	Lime.	Magnesia.	Phosphoric Acid.	Chlorin.	Silica.
Mangolds:	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs	lbs.	lbs.
root, 22 tons..	49,280	5,914	426	87	4.9	222.8	69.4	15.9	18.3	36.4	42.5	8.7
leaf.	18,233	1,654	254	51	9.1	77.9	49.3	27.0	24.2	16.5	40.6	9.2
Total crop..	67,513	7,568	680	138	14.0	300.7	187.7	42.9	42.5	52.9	83.1	17.9
Potato:												
tubers, 6 tons	13,440	3,360	127	47	2.7	76.5	3.8	3.4	6.3	21.5	4.4	2.6
Beech:												
wood.	.....	2,822	26	10	....	4.2	0.8	12.9	3.4	1.5	...	2.2
leaf litter. ...	... ..	2,975	166	39	..	8.8	1.6	73.1	10.9	9.3	. .	53.9
T'l produce.	......	5,797	192	49	....	13.0	2.4	86.0	14.3	10.8	....	56.1
Scotch pine:												
wood	......	2,884	15	....	....	2.3	0.2	9.0	1.5	1.0	..	0.5
leaf litter.....	......	2,845	42	...	...	4.3	1.7	16.8	4.3	3.3	..	5.8
T'l produce.	......	5,729	57	...	...	6.6	1.9	25.8	5.8	4.3	...	6.3
Spruce fir:												
wood	......	3,064	20	....	....	3.6	0.4	8.2	1.8	1.3	....	2.9
leaf litter.....	....	2,683	121	....	....	4.3	1.5	54.4	6.2	5.7	...	44.3
T'l produce.	......	5,747	141	....	...	7.9	1.9	62.6	8.0	7.0	....	47.2

SOILING CROPS ADAPTED TO NORTHERN NEW ENGLAND STATES. (LINDSEY.)

(For 10 cows' entire soiling.)

Kind.	Seed per Acre.	Time of Seeding.	Area.	Time of Cutting
Rye	2 bush....	Sept. 10–15	⅛ acre	May 20—May 30
Wheat..........	"	"	"	June 1—June 15
Red clover ..	20 lbs..........	July 15—Aug. 1	"	June 15—June 25
Grass and clover..........	⅛ bu. redtop... 1 peck timothy. 10 lbs. red clover	Sept.	⅜ acre	June 15—June 30
Vetch and oats.	3 bush. oats.... 50 lbs. vetch ...	April 20	⅛ acre	June 25—July 10
" " "	" " ...	" 30	"	July 10—July 20
Peas and oats..	1⅛ bu. Canada 1⅛ bu. oats ..	" 20	"	June 25—July 10
" " "	" "	" 30	"	July 10—July 20
Barnyard millet..	1 peck	May 10	⅛ acre	July 25—Aug. 10
" " ..	"	" 25	"	Aug. 10—Aug. 20
Soja bean (medium green)....	18 quarts.......	" 20	"	Aug. 25—Sept. 15
Corn	....	" 20	"	Aug. 25—Sept. 10
"	....	" 30	"	Sept. 10—Sept. 20
Hungarian.......	1 bush.	July 15	⅛ acre	Sept. 20—Sept. 30
Barley and peas	1⅛ bu. peas.... 1⅛ bu. barley..	Aug. 5	1 acre	Oct. 1—Oct. 20

TIME OF PLANTING AND FEEDING SOILING CROPS. (PHELPS.)

Kind of Fodder.	Amount of Seed per Acre	Approximate Time of Seeding.	Approximate Time of Feeding.
1. Rye fodder	2½ to 3 bu.	Sept. 1	May 10–20
2. Wheat fodder	2½ to 3 bu.	Sept. 5–10	May 20, June 5
3. Clover	20 lbs.	July 20–30	June 5–15
4. Grass (from grass-lands)			June 15–25
5. Oats and peas	2 bu. each	April 10	June 25, July 10
6. " " "	2 " "	" 20	July 10–20
7. " " "	2 " "	" 30	" 20, Aug. 1
8. Hungarian	1½ bushels	June 1	Aug. 1–10
9. Clover rowen (from 3)			" 10–20
10. Soja beans	1 bushel	May 25	" 20, Sept. 5
11. Cow-peas	1 bushel	June 5–10	
12. Rowen grass (from grass-lands)			Sept. 5–20 " 20–30
13. Barley and peas	2 bu. each	Aug. 5–10	Oct. 1–30

The dates given in the table apply to Central Connecticut and regions under approximately similar conditions.

CROPS FOR PARTIAL SOILING FOR ILLINOIS DURING MIDSUMMER. (FRASER.)

Kinds of Fodder.	Amount of Seed per Acre.	Approx. Time of Seeding.	Approx. Time of Feeding.
1. Corn, early, sweet, or dent	6 qts.	May 1	July 1–Aug. 1
2. Corn, medium, dent	5 "	" 15	Aug. 1–Sept. 30
3. Cow peas	1 bu.	" 15	" 1– " 15
4. Soy beans	1 "	" 15	" 1– " 15
5. Oats and Canada peas	1 bu. each	April 15	July 1–July 15
6. " " " "	1 " "	May 1	" 15–Aug. 1
7. Rape (Dwarf Essex)	4 lbs.	" 1	" 1– " 1
8. " second sowing	4 "	June 1	Aug. 1–Sept. 1
9. " third sowing	4 "	July 1	Sept. 1–Oct. 1

REPLACING WINTER-KILLED CLOVER.

The following brief article gives a list of forage plants that will be found suitable for furnishing green feed for cattle and other farm animals in regions where the clover has been winter-killed. It was originally published as a newspaper bulletin from the Wisconsin Experiment Station and is written with special reference to conditions in the Northwestern States.

How to get the Quickest Pasture.—A field of oats or barley will furnish the quickest pasture it is possible to obtain, barley being a little earlier than oats. Sow oats or barley

as for a grain crop, and when the young plants are a few inches high, turn in the stock and treat the field as though it were a pasture. If the cattle do not graze the field evenly, run the mower over the patches where the growth is excessive. By keeping the growth short it will last much longer than if allowed to head out. It is recommended that, as an experiment, clover and timothy seed be sown with a part at least of the oats or barley, in the hope of securing a stand for next season. The farmer who can pasture his oat or barley field and get a crop of clover started at the same time will be one year ahead. This recommendation must be regarded as an experiment, but it has been successfully tried in a number of cases.

Oats and Peas.—Let the farmer also put in a patch of oats and peas. Sow a bushel and a half of peas per acre, covering three or four inches deep on light soil, and one or two inches on heavy soil. After these are planted sow or drill the oats in the usual manner. Cut the green forage for the cattle, or cure for hay.

Millet.—For winter hay sow millet or Hungarian grass from the 10th to the 30th of June, using from a bushel to a bushel and a half of seed per acre. When the seed-heads are coming into blossom, cut and cure for hay. Millet or Hungarian grass will yield from one ton to two and a half tons of good quality hay per acre. Horses should not be given over one feed of millet hay per day.

Corn Fodder.—Any variety of corn will do for green or dry forage, the early kinds being the most suitable for early fall feed. Sweet corn is very satisfactory because the stalks are soft and palatable. Plant in hills or drills just thick enough to decrease the size of the ears to about half their normal size. Begin feeding as soon as the ears are glazing, and continue with the dry forage throughout the winter. From three to six tons per acre of winter forage, suitable for all kinds of farm stock, can be secured from a corn crop grown on good land. (Henry.)

SUCCESSION OF SOILING CROPS FOR DAIRY COWS. (CARLYLE.)

Crop.	Pounds Seed per Acre.	Time of Sowing.	Approximate				Degree of Maturity.	Palatability.
			Time of Cutting.	Days from Sowing to Harvest.	Daily Feed per Cow.	Acreage for Ten Cows.		
Fall rye.	168	Sept. 10	May 15–June 1	248	38	$\frac{1}{3}$	Before blooming	Poor
Alfalfa.	20	Mar. 20	June 1–15.	72	36	$\frac{1}{3}$	Before blooming	Fair
Red clover.	15	....	June 15–25.	......	36	$\frac{1}{3}$	In bloom	Fair
Peas and oats.	P 60, O 48	April 16	June 25–July 5.	70	32	$\frac{1}{6}$	In milk	Average
Peas and oats.	P 60, O 48	April 26	July 5–15	70	32	$\frac{1}{6}$	In milk	Average
Oats.	80	May 5	July 15–25	70	32	$\frac{1}{6}$	In milk	Average
2d crop alfalfa.	....	....	July 15–30	......	36	......	Before blooming	Average
Rape.	2.5	May 26	Aug. 1–15.	67	42	$\frac{1}{8}$	Mature	Good
Flint corn.	....	May 20	Aug. 15–25.	86	40	$\frac{1}{8}$	In silk	Very good
Sorghum.	50	June 1	Aug. 25–Sept. 10.	86	39	$\frac{1}{16}$	When well headed	Very good
Evergreen sweet corn.	....	May 31	Sept. 10–25.	102	39	$\frac{1}{8}$	In silk	Very good
Rape.	2.5	July 20	Sept. 25–Oct. 10.	67	42	$\frac{1}{8}$	Mature	Good

Remarks.—Feed in stable during day and turn cows on pasture at night, or feed in the pasture spreading the forage. After cutting rye use same ground for the rape, flint corn, and sorghum, and after cutting peas and oats use same ground for evergreen sweet corn and rape. After oats sow peas and barley. In this way a single acre only is required (except alfalfa, which is permanent), and the forage produced is ample amount of good succulent feed for ten cows for nearly half the year. (See Bulletin No. 103, Wisconsin Experiment Station.)

CYLINDRICAL SILOS.

Approximate Capacity of Cylindrical Silos for Well-matured Corn Silage, in Tons. (KING.)

Depth of Silo, Ft.	Inside Diameter of Silo, Feet.												
	10	12	14	15	16	18	20	21	22	23	24	25	26
20	26	38	51	59	67	85	105	115	127	138	151	163	177
21	28	40	55	63	72	91	112	123	135	148	161	175	189
22	30	43	59	67	77	97	120	132	145	158	172	187	202
23	32	46	62	72	82	103	128	141	154	169	184	199	216
24	34	49	66	76	87	110	135	149	164	179	195	212	229
25	36	52	70	81	90	116	143	158	173	190	206	224	242
26	38	55	74	85	97	123	152	168	184	201	219	237	257
27	40	58	78	90	103	130	160	177	194	212	231	251	271
28	42	61	83	95	108	137	169	186	204	223	243	264	285
29	45	64	88	100	114	144	178	196	215	235	265	278	300
30	47	68	93	105	119	151	187	206	226	247	269	292	315
31	49	70	96	110	125	158	195	215	236	258	282	305	330
32	51	73	101	115	131	166	205	226	248	271	295	320	346
36	64	105	130	139	155	190	235	....	....	....	....	....	....
40	75	121	150	165	180	228	279	....	....	....	....	....	....

RELATION OF HORIZONTAL FEEDING AREA AND NUMBER OF COWS KEPT, FOR SILOS 24 AND 30 FEET DEEP. (KING.)

No. of Cows.	Feed for 240 Days.				Feed for 180 Days.			
	Silo 24 Feet Deep.		Silo 30 Feet Deep.		Silo 24 Feet Deep.		Silo 30 Feet Deep.	
	Rate 1.2 In. Daily.		Rate 1.5 In. Daily.		Rate 1.6 In. Daily.		Rate 2 In. Daily.	
	Tons.	Inside Diam.	Tons.	Inside Diam.	Tons.	Inside Diam.	Tons.	Inside Diam.
		Feet.		Feet.		Feet.		Feet.
10........	48	12	48	10	36	10	36	9
15........	72	15	72	12	54	13	54	11
20........	96	17	96	14	72	15	72	12
25........	120	19	120	16	90	16	90	14
30........	144	21	144	18	108	18	108	15
35........	168	22	168	19	126	19	126	16
40........	192	24	192	20	144	21	144	18
45........	216	26	216	21	162	22	162	19
50........	240	27	240	23	180	23	180	20
60........	288	29	288	25	216	25	216	21
70........	336	32	336	27	252	27	252	23
80........	384	34	384	29	288	29	288	25
90........	432	36	432	30	324	31	324	26
100........	480	38	480	32	360	33	360	28

RELATION BETWEEN SIZE OF SILOS AND NUMBER OF COWS THEY WILL KEEP.

Dimensions.	Capacity, Tons.	Acres to Fill, 15 Tons to Acre.	Cows it Will Keep 6 Months, 40 lbs. Feed per Day.
10×20	28	2	8
12×20	40	3	11
12×24	49	3⅔	13
12×28	60	4	15
14×22	61	4½	17
14×24	67	4⅔	19
14×28	83	5⅔	22
14×30	87	6	23
16×24	93	6⅔	24
16×26	97	7	26
16×30	119	8	29
18×30	151	10⅛	37
18×36	180	12½	45

NUMBER OF PLANTS FOR AN ACRE OF GROUND.

Distance apart, Inches.	Number of Plants.
3×3	696,960
4×4	392,040
6×6	174,240
9×9	77,440
Feet.	
1×1	43,560
1½×1½	19,360
2×1	21,780
2×2	10,890
2½×2½	6,960
3×1	14,520
3×2	7,260
3×3	4,840
3½×3½	3,555
4×1	10,890
4×2	5,445
4×3	3,630
4×4	2,722
4½×4½	2,151
5×1	8,711
5×2	4,356
5×3	2 904
5×4	2,178
5×5	1,742
5½×5½	1,417

Distance apart, Feet.	Number of Plants.
6×6	1,210
6½×6½	1,031
7×7	881
8×8	680
9×9	537
10×10	435
11×11	360
12×12	302
13×13	257
14×14	222
15×15	193
16×16	170
16½×16½	160
17×17	150
18×18	134
19×19	120
20×20	108
25×25	69
30×30	48
33×33	40
40×40	27
50×50	17
60×60	12
66×66	10

NUMBER OF HILLS OR PLANTS ON AN ACRE OF land, for any distance apart, from 10 in. to 6 ft., the lateral and longitudinal distances being unequal. (WARING.)

Distance	10 in.	12 in.	15 in.	18 in.	20 in.	2 ft.	2½ ft.	3 ft.	3½ ft.	4 ft.	4½ ft.	5 ft.	5½ ft.	6 ft.
in.														
10	62726													
12	52272	43560												
15	41817	34848	27878											
18	34848	29040	23232	19360										
20	31363	26136	20908	17424	15681									
ft.														
2	26136	21780	17424	14520	13068	10890								
2½	20908	17424	13939	11616	10454	8712	6969							
3	17424	14520	11616	9680	8712	7260	5808	4840						
3½	14935	12446	9953	8297	7467	6223	4976	4148	3565					
4	13068	10890	8712	7260	6534	5445	4356	3630	3111	2722				
4½	11616	9680	7744	6453	5808	4840	3872	3226	2767	2420	2151			
5	10454	8712	6969	5808	5227	4356	3484	2904	2489	2178	1936	1742		
5½	9504	7920	6336	5280	4752	3960	3168	2640	2263	1980	1760	1584	1440	
6	8712	7260	5808	4840	4356	3630	2904	2420	2074	1865	1613	1452	1320	1210

YIELD OF A GOOD CROP OF FARM PRODUCTS PER ACRE. (VARIOUS AUTHORITIES.)

Alfalfa	4 tons	Oats	50 bus.
Barley	50 bus.	Potatoes	200 "
Beans, field	20 "	Rape	20 tons
Buckwheat	20 "	Rice	50 bus.
Cabbage	3 tons	Rutabagas	25 tons
Clover	2½ "	Rye	25 bus.
Corn (shelled)	60 bus.	Sorghum	10 tons
Cotton	1 bale	Sugar beets	15 "
Cowpea	15 bus.	Sugar-cane	20 "
Field peas	20 "	Sweet potatoes	200 bus.
Flax	15 "	Tobacco	1200 lbs.
Hay	2 tons	Turnips	20 tons
Mangels	24 "	Wheat (spring)	25 bus.
Millet	3 "	Wheat (winter)	30 "

GARDENER'S PLANTING TABLE. (BEATTIE.)

Quantity of seeds or number of plants required for a row 100 feet in length, with distances to plant, times for planting, and period required for production of crop.

Brackets indicate that a late or second crop may be planted the same season.

Kind of Vegetable.	Seeds or Plants for 100 Feet of Row.	Distance for Plants to Stand— Rows Apart. Horse Cultiv.	Rows Apart. Hand Cultiv.	Plants Apart in Rows.	Depth of Planting.	Time of Planting in Open Ground, North.	Ready for Use after Planting.
Artichoke, Globe	½ oz.	3–4 ft.	2–3 ft.	2–3 ft.	1–2 in.	Early spring	15 mos.
Artichoke, Jerusalem	2 qts.	3–4 ft.	1–2 ft.	1–2 ft.	2–3 in.	Early spring	6–8 mos.
Asparagus, seed	1 oz.	30–36 in.	1–2 ft.	3–5 in.	1–2 in.	Early spring	3–4 yrs.
Asparagus, plants	60–80	3–5 ft.	12–24 in.	15–20 in.	3–5 in.	Early spring	1–3 yrs.
Beans, bush	1 pint	30–36 in.	18–24 in.	5 or 8 to ft.	½–2 in.	April to July	40–65 d.
Beans, pole	½ pint	3–4 ft.	3–4 ft.	3–4 ft.	1–2 in.	May and June	50–80 d.
Beets	2 oz.	24–36 in.	12–18 in.	5 or 6 to ft.	1–2 in.	April to August	60–80 d.
Brussels sprouts	¼ oz.	30–36 in.	24–30 in.	16–24 in.	½ in.	May and June	90–120 d.
Cabbage, early	¼ oz.	30–36 in.	24–30 in.	12–18 in.	½ in.	March and April. (Start in hotbed during February.)	90–130 d.
Cabbage, late	¼ oz.	30–40 in.	24–36 in.	16–24 in.	½ in.	May and June	90–130 d.
Carrot	1 oz.	30–36 in.	18–24 in.	6 or 7 to ft.	½ in.	April to June	75–110 d.
Cauliflower	¼ oz.	30–36 in.	24–30 in.	14–18 in.	½ in.	April to June. (Start in hotbed during February or March.)	100–130 d.
Celery	¼ oz.	3–6 ft.	18–36 in.	4–8 in.	⅛ in.	May and June. (Start in hotbed or cold frame during March or April.)	120–150 d.
Chicory	¼ oz.	30–36 in.	18–24 in.	4 or 5 to ft.	½ in.	May and June	5–6 mos.
Citron	1 oz.	8–10 ft.	8–10 ft.	8–10 ft.	1–2 in.	May and June	100–130 d.
Corn salad	2 oz.	30 in.	12–18 in.	5 or 6 to ft.	½–1 in.	March to September.	60 d.
Corn, sweet	¼ pint	36–42 in.	30–36 in.	30–36 in.	1–2 in.	May to July	60–100 d.
Cress upland	½ oz.	30 in.	12–18 in.	4 or 5 to ft.	½–1 in.	Mar. to May [September]	30–40 d.
Cress water	½ oz.	Broadcast	...	...	On surfa'e	April to September	60–70 d.
Cucumber	½ oz.	4–6 ft.	4–6 ft.	4–6 ft.	1–2 in.	April to July	60–80 d.
Dandelion	¼ oz.	30 in.	18–24 in.	8–12 in.	½ in.	Early spring	6–12 mos.

Horse-radish........	70 roots	30–40 in.	24–30 in.	14–20 in.	3–4 in.	Early spring..................	1–2 yrs.
Kale, or borecole....	¼ oz.	30–36 in.	18–24 in.	18–24 in.	½ in.	Aug. and Sept. [Mar. and Ap.]	90–120 d.
Kohl-rabi...........	¼ oz.	30–36 in.	18–24 in.	4–8 in.	½ in.	March to May...............	60–80 d.
Leek...............	½ o	30–36 in.	14–20 in.	4–8 in.	1 in.	March to May...............	120–180 d.
Lettuce............	½ oz.	30 in.	12–18 in.	4–6 in.	½ in.	March to September..........	60–90 d.
Melon, musk........	½ oz.	6–8 ft.	6–8 ft.	Hills 6 ft.	1–2 in.	April to June. (Start early pl'ts in hotbed during March.)	120–150 d.
Melon, water........	1 oz.	8–12 ft.	8–12 ft.	Hills 10 ft.	1–2 in.	May and June...............	100–120 d.
Mustard.............	¼ oz.	30–36 in.	12–18 in.	4 or 5 to ft.	¼ in.	March to May. [September]...	60–90 d.
N. Z. spinach.......	1 oz.	36 in.	24–36 in.	12–18 in.	1–2 in.	Early spring.................	60–100 d.
Okra, or gumbo.....	2 oz.	4–5 ft.	3–4 ft.	24–30 in.	1–2 in.	May and June...............	90–140 d.
Onion, seed.........	1 oz.	24–36 in.	12–18 in.	4 or 5 to ft.	½–1 in.	April and May...............	130–150 d.
Onion, sets.........	1 qt. sets	24–36 in.	12–18 in.	4 or 5 to ft.	1–2 in.	Autumn and February to May.	90–120 d.
Parsley.............	¼ oz.	24–36 in.	12–18 in.	3–6 in.	⅛ in.	September and early spring....	90–120 d.
Parsnip.............	½ oz.	30–36 in.	18–24 in.	5 or 6 to ft.	½–1 in.	April and May...............	125–160 d.
Peas...............	1–2 pints	3–4 ft.	30–36 in.	15 to ft.	2–3 in.	March to June...............	40–80 d.
Pepper.............	⅛ oz.	30–36 in.	18–24 in.	15–18 in.	½ in.	May and June. (Start early plants in hotbed during Mar.)	100–140 d.
Potato, Irish........	5 lbs. (or 9 bu.p.acre)	30–36 in.	24–36 in.	14–18 in.	4 in.	March to June...............	80–140 d.
Potato, sweet.......	3 lbs. (or 75 slips)	3–5 ft.	3–5 ft.	14 in.	3 in.	May and June. (Start plants in hotbed during April.)	140–160 d.
Pumpkin............	½ oz.	8–12 ft.	8–12 ft.	Hills 8–12 ft.	1–2 in.	May to July.................	100–140 d.
Radish.............	1 oz.	24–36 in.	12–18 in.	8–12 to ft.	½–1 in.	March to September..........	20–40 d.
Rhubarb, seed	½ oz.	36 in.	30–36 in.	6–8 in.	½–1 in.	Early spring.................	2–4 yrs.
Rhubarb, plants.....	33 plants	3–5 ft.	3–5 ft.	3 ft.	2–3 in.	Autumn or early spring.......	1–3 yrs.
Ruta-baga..........	¼ oz.	30–36 in.	18–24 in.	6–8 in.	½–1 in.	May and June...............	60–80 d.
Salsify.............	1 oz.	30–36 in.	18–24 in.	2–4 in.	½–1 in.	Early spring.................	120–180 d.
Spinach............	1 oz.	30–36 in.	12–18 in.	7 or 8 to ft.	1–2 in.	Sept. or very early spring.....	30–60 d.
Squash, bush.......	½ oz.	3–4 ft.	3–4 ft.	Hills 3–4ft	1–2 in.	April to June...............	60–80 d.
Squash, late........	½ oz.	7–10 ft.	7–10 ft.	Hills 7–9ft	1–2 in.	April to June...............	120–160 d.
Tomato.............	⅛ oz.	3–5 ft.	3–4 ft.	3 ft.	½–1 in.	May and June. (Start early plants in hotbed during February and March.)	100–140 d.
Turnip.............	½ oz.	24–36 in.	18–24 in.	6 or 7 to ft.	¼–½ in.	April. [July]................	60–80 d.
Vegetable marrow ..	½ oz.	8–12 ft.	8–12 ft.	Hills 8–9ft.	1–2 in.	April to June...............	110–140 d.

DISTANCES APART FOR FRUIT TREES,
Time Required to Bear Fruit, and Longevity. (Bailey.)

	Usual Distances.	Time Required to Bear.	Average Profitable Longevity under high Culture.
Apples	30 to 40 ft. each way.	3 yrs. Good crop in about 10 years	25-40 yrs.
" dwarf	10 ft. each way	...	...
Blackberry	4×7 to 6×8 ft.	1 yr. Good crop in 2-3 years	8-12 yrs.
Currant	4×5 feet	1 yr. Good crop in 2-3 years	20 years.
Gooseberry	4×5 feet	1 yr. Good crop in 2-3 years	20 years.
Orange and lemon	25 to 30 ft. each way.	2-3 yrs. Good crop 2-3 years later	50 or more.
Peach	16 to 20 ft. each way.	2 yrs. Good crop in 4 years	8-12 yrs.
Pears	20 to 30 ft. each way.	3 or 4 yrs. Fair crop in 6-12 years	50-75 yrs.
Persimmon	20 to 25 ft. each way.	1 to 3 yrs.	25-40 yrs.
Plum	16 to 20 ft. each way.	3 yrs. Good crop in 5 to 6 years	20-25 yrs.
Raspberry	3×6 feet	1 yr. Good crop in 2 or 3 years	8-12 yrs.
Strawberry	1×3 or 4 feet	1 yr. Heaviest crop usually in 2 years	3 years.

TIME OF GERMINATION OF VEGETABLE SEEDS AND MATURITY TABLE. (Morse.)

	Time of Germination.	Maturity Table.		Time of Germination.	Maturity Table.
	Days.	Days.		Days.	Days.
Bean	5-10	40-60	Onion	7-10	130-150
Beet	7-10	40-50	Parsley	......	90-120
Cabbage	5-10	90-115	Parsnip	10-20	120-150
Carrot	12-20	90-110	Pea	6-10	40-90
Cauliflower	5-10	....	Pepper	10-14	140-160
Celery	10-20	150-160	Radish	3-6	20-30
Corn (sweet)	5-8	65-90	Salsify	7-12	....
Cucumber	6-10	55-75	Spinach	......	60-80
Endive	5-10	....	Squash	......	120-150
Lettuce	6-8	65-75	Tomato	6-12	110-120
Melon, water	......	125-150	Turnip	4-8	60-75
" musk	......	125-150			

AVERAGE YIELDS PER ACRE OF VARIOUS CROPS. (BAILEY.)

Apples.........	A tree 20 to 30 years old may be expected to yield from 25 to 40 bus. every alternate year.
Artichoke......	200 to 300 bus.
Beans, green or snap..........	75 to 120 bus.
Bean, Lima. ...	75 to 100 bus. of dry beans.
Beet.......... ...	400 to 700 bus.
Carrots.........	400 to 700 bus.
Corn...........	50 to 75 bus., shelled.
Cranberry......	100 to 300 bus.; 900 bus. have been reported.
Cucumber.......	About 150,000 fruits per acre.
Currant.........	100 bus.
Egg-plant.......	1 or 2 large fruits to the plant for the large sorts like New York purple, and from 3 to 8 fruits for the smaller varieties.
Gooseberry......	100 bus.
Grape..........	3 to 5 tons. Good raisin vineyards in California, 15 years old, will produce from 10 to 12 tons.
Horse-radish....	3 to 5 tons.
Kohlrabi........	500 to 1000 bus.
Onion, from seed	300 to 800 bus.; 600 bus. is a large average yield.
Parsnip....	500 to 800 bus.
Pea, green, in pod	100 to 150 bus.
Peach..........	In full bearing a peach-tree should produce from 5 to 10 bus.
Pear	A tree 20 to 25 years old should give from 25 to 45 bus.
Pepper..	30,000 to 50,000 fruits.
Plum...........	5 to 8 bus. may be considered an average crop for an average tree.
Potato..........	100 to 300 bus.
Quince..........	200 to 400 bus.
Raspberry and blackberry....	50 to 100 bus.
Salsify..........	200 to 300 bus.
Spinach.........	200 barrels.
Strawberry......	75 to 250 or even 300 bus.
Tomato.........	8 to 16 tons.
Turnip..........	600 to 1000 bus.

A COMBINED FRUIT AND VEGETABLE GARDEN.

(CORBETT.)

The following plan is suggested for a combined fruit and vegetable garden for a farm or city home on a lot 100×80 ft., the fruit garden occupying an area of 60×80 ft. and the vegetable garden an area of 40×80 ft.

A. *Fruit-bearing Plants* that can be grown on an area of 60×80 ft.:

32 grape-vines, dispersed at intervals of 10 ft. around the entire garden.

3 rows of dwarf pears, each containing 6 trees (rows Nos. 2, 10, 14).

1 row of peaches, 6 trees (row No. 4).

1 row of cherries, 6 trees (row No. 8).

1 row of dwarf apples, 6 trees (row No. 6).

1 row of plums, 6 trees (row No. 12).

1 row, 20 specimens blackberries (row No. 1).

2 rows, 40 specimens black-caps (rows Nos. 3 and 5).

2 rows, 40 specimens red raspberries (rows Nos. 7 and 9).

3 rows, 300 specimens strawberries (rows Nos. 11, 13, and 15).

B. *Vegetable Plants* that can be grown on an area of 40×80 ft.:

1 row, ½ row rhubarb, ½ row asparagus (occupying 4 ft.).

1 row, salsify (1½ ft.).

1 row, parsnips (1½ ft.).

2 rows, beets (3 ft.).

1 row, egg-plant, plants set 18 in. apart, 2 doz. (3 ft.).

2 rows, tomatoes, plants set 2 ft. apart, 2 doz. (6 ft.).

1 row, summer squash, 12 hills, 3 ft. apart (3 ft.).

2 rows, cucumber, 24 hills, 3 ft. apart (1 ft.).

2 rows, early cabbage, 4 doz. plants, set 18 in. apart (4 ft.).

2 rows, late cabbage, 4 doz. plants, set 18 in. apart (4 ft.).

1 row, early celery, 6 doz. plants, set 6 in. apart (2 ft.).

8 rows, peas, plant in double rows, 4 in. apart; follow by 6 rows, late celery, 36 plants (16 ft.).

2 rows, lima beans, 4 doz. hills, 18 in. apart (4 ft.).

6 rows, bunch beans; in succession sow seeds in drills, placing

seeds about 6 in. apart in the row; follow by late cabbage, turnips, or spinach (12 ft.).

2 rows, radishes, 4 sowings, planted in double rows 6 in. apart (3 ft.).

2 rows, lettuce, 2 sorts, adapted for early and late use (3 ft.).

1 row, parsley and pepper grass (1½ ft.).

The space occupied by the last three plants may be given over to winter squashes by planting these before other crops are off the ground. (See Farmers' Bull. No. 154.)

A VEGETABLE FORCING CALENDAR. (Wood.)

	Night Tem. ° F.	Day Tem. ° F.	From Seed.	Soil.	Notes.
Tomato. .	60–65	75	5 mos.	Rich loose loam.	Transplant twice into pots, hand pollinate, grow on benches.
Lettuce. .	45–50	55–65	10–12 w.	Open, porous, dry on surface.	Solid or ground beds best, transplant.
Parsley. . .	45–50	55–65	8 wks.	Open, well drained.	Best from spring-sown plants; transplant and cut back.
Water-cress	45–50	55–65	4–6 wks.	Moist, cool uniformly	Not at all particular, grow under bench anywhere.
Pepper-cress	45–50	55–65	3–4 wks.	Well drained cool soil.	Grow in beds with cauliflower, lettuce, etc.
Radishes.	45–50	55–65	5–6 wks.	Warm, quick no coarse manure.	Rapid growth essential; no old manure.
Beans. . . .	60–65	70–80	6–8 wks.	"Quick," i.e., loam and ¼ thoroughly rotted man'e	Best as catch crop between melons and tomatoes.
Peas.	45–50	55–65	70–80 d.	Solid beds of rich, sandy soil.	Do not yield heavily, and are useless after April 1.
Cauli-flower	50	60–65	4–5 mos.	Solid bed garden loam and ¼ rotten manure.	Transplant once, abundance of air and free drainage, yet plenty of water.
Mush-rooms	50–60	50–60	6–8 wks.	Moist (not wet) manure, 4 parts, loam, 1 part.	Grow under benches, or anywhere that even temperature can be had.
Asparagus	50–55	60–70	2–3 wks.	Pack under benches in any material.	3–4 years' roots from field; crop depends on vigor.
Spinach. .	45–50	55–65	8–10 w.	Open, porous, well enriched.	Grow as a catch crop between cauliflower, etc.

SEASONS OF VARIETIES OF APPLES IN VARIOUS STORAGES. (Beach and Clark.)

	Season in			Difference in Season between		
	Chemical Cold Storage	Ice Storage	Cellar Storage	Cellar and Ice Storage.	Ice and Chemical Storage.	Cellar and Chemical Storage.
				Mos.	Mos.	Mos.
Alexander *	Nov.	Nov.	Oct.	1	0	1
Baldwin†	June 15	May 1	April 1	1	1½	2½
" ‡	May	April	March	1	1	2
Esopus, Spitzenburg †	June 15	June 1	May 1	1	½	1½
" " ‡	March	....	Jan.	......	......	2
Fallawater *	April	March	Jan.	2	1	3
" †	Mar. 30	Mar. 20	Mar. 1	½	½	1
" ‡	May	....	Jan.	......	......	4
Fall Pippin *	Nov.	Nov.	Oct.	1	0	1
Fameuse *	Dec.	Dec.	Oct.	2	0	2
" †	April 1	Feb. 15	Feb. 1	½	1½	2
Hubbardston *	March	Feb.	Dec.	2	1	3
Jonathan ‡	March	....	Jan.	......	......	2
Maiden Blush *	Nov.	Nov.	Oct.	1	0	1
McIntosh ‡	Jan.	....	Nov.	......	......	2
Northern Spy ‡	April	March	Feb.	1	1	2
R. I. Greening *	Feb.	Feb.	Dec.	2	0	2
" " ‡	April	March	Feb.	1	1	2

*, †, ‡, Reports of Chicago, Minneapolis, and New York Commission men, respectively.

PACKAGES USED IN SHIPPING FRUIT. (Waugh.)

Fruit.	Package.	Approximate Cost.
Apple	Barrel, 100 quarts, or 3 bushels	$25 the 100
	Boxes, various sizes	Variable
	Slat crate, mostly half bushel	$4.50 the 100
	Basket, mostly bushel	$1 to $1.25 a doz.
Peach	Delaware basket	$2 to $3 the 100
	Michigan basket, one-fifth bushel	$3 the 100
	Six-basket carrier	$7 to $10 the 100
Pear	Barrel, 3 bushels	$25 the 100
	Half-barrel, 1½ bushels	$15 to $20 the 100
	Boxes and baskets of various kinds	
Plum	Grape basket, 10 pounds	$2.50 the 100
	Six-basket carrier	$7 to $10 the 100

PACKAGES USED IN SHIPPING FRUIT—*Continued.*

Fruit.	Package.	Approximate Cost.
Cherry	Strawberry quart boxes and crates..	Quart boxes, $2 to $3 the 1000; 16-qt. crates, $5 to $6 the 100
	5-pound grape basket	....
Quince......	Slat crate, ⅓ bushel	$3 the 100
	" " ½ "	$4.50 the 100
	" " 1 "	$7 the 100
	Baskets in various styles. Also barrels.	
Berries	Quart boxes in crates	Quart boxes, $2 to $3 the 1000 16-qt. crates, $5 to $6 the 100 24-qt. crates, $7 to $15 the 100

RELATION OF SPECIFIC GRAVITY,
Dry Matter, and Starch Content of Potatoes.
(WOLFF)

Spec. Grav.	Dry Substance.	Starch Content.	Spec. Grav.	Dry Substance.	Starch Content.	Spec. Grav.	Dry Substance.	Starch Content.
	Per ct.	Per ct.		Per ct.	Per ct.		Per ct.	Per ct.
1.080	19.7	13.9	1.107	25.5	19.7	1.134	31.3	25.5
.081	19.9	14.1	.108	25.7	19.9	.135	31.5	25.7
.082	20.1	14.3	.109	25.9	20.1	.136	31.7	25.9
.083	20.3	14.5	1.110	26.1	20.3	.137	31.9	26.1
.084	20.5	14.7	.111	26.3	20.5	.138	32.1	26.3
.085	20.7	14.9	.112	26.5	20.7	.139	32.3	26.5
.086	20.9	15.1	.113	26.7	20.9	1.140	32.5	26.7
.087	21.2	15.4	.114	26.9	21.1	.141	32.8	27.0
.088	21.4	15.6	.115	27.2	21.4	.142	33.0	27.2
.089	21.6	15.8	.116	27.4	21.6	.143	33.2	27.4
1.090	21.8	16.0	.117	27.6	21.8	.144	33.4	27.6
.091	22.0	16.2	.118	27.8	22.0	.145	33.6	27.8
.092	22.2	16.4	.119	28.0	22.2	.146	33.8	28.0
.093	22.4	16.6	1.120	28.3	22.5	.147	34.1	28.3
.094	22.7	16.9	.121	28.5	22.7	.148	34.3	28.5
.095	22.9	17.1	.122	28.7	22.9	.149	34.5	28.7
.096	23.1	17.3	.123	28.9	23.1	1.150	34.7	28.9
.097	23.3	17.5	.124	29.1	23.3	.151	34.9	29.1
.098	23.5	17.7	.125	29.3	23.5	.152	35.1	29.3
.099	23.7	17.9	.126	29.5	23.7	.153	35.4	29.6
1.100	24.0	18.2	.127	29.8	24.0	.154	35.6	29.8
.101	24.2	18.4	.128	30.0	24.2	.155	35.8	30.0
.102	24.4	18.6	.129	30.2	24.4	.156	36.0	30.2
.103	24.6	18.8	1.130	30.4	24.6	.157	36.2	30.4
.104	24.8	19.0	.131	30.6	24.8	.158	36.4	30.6
.105	25.0	19.2	.132	30.8	25.0	.159	36.6	30.8
.106	25.2	19.4	.133	31.0	25.2	1.160	36.9	31.1

SPECIFIC GRAVITY, SUGAR CONTENT, AND BOILING-POINT OF MAPLE SIRUP.

(COOKE AND HILLS.)

Degrees, Baumé Hydrometer.	Specific Gravity.	Degrees, Brix Hydrometer.	Approximate per cent of Pure Sugar.	Temperature of Boiling-point.	Weight per Gallon.	Relative Value per Gallon.
25	1.205	44.9	41	215.0° F.	10.0 lbs.	68
26	1.215	46.8	43	215.1	10.1	72
27	1.226	48.7	45	215.3	10.2	75
28	1.236	50.5	47	215 6	10.3	78
29	1.246	52.4	49	215.9	10.4	82
30	1.257	54.3	51	216.2	10.5	85
31	1.268	56.2	53	216.6	10.6	88
32	1.279	58.1	54	217.0	10.7	90
33	1.290	60.0	56	217.4	10.7	93
34	1.302	62.0	58	218.1	10.8	97
35	1.313	63.9	60	218.6	10.9	100
36	1.325	65.8	62	219.5	11.0	103
37	1.337	67.8	64	220.3	11.1	107
38	1.350	69.8	66	221.2	11.2	110
39	1.362	71.8	68	222.0	11.3	113
40	1.374	73.7	70	223.2	11.4	117
41	1.387	75.7	72	224.5	11.6	120
42	1.400	77.7	74	226.0	11.7	123
43	1.415	79.8	75	227.8	11.8	125
44	1.428	81.8	77	229.7	11.9	128
45	1.442	83.9	79	231.8	12.0	132
46	1.457	86.0	81	234.0	12.1	135
47	1.471	88.1	83	236.3	12.3	138
48	1.486	90.2	85	238.7	12.4	142

"The per cents of sugar given are calculated for a fairly good sirup. The relative values in the last column are based on these per cents, but will be nearly the same for all except the poorest of sirups. The relative value is made use of as follows: A weight of 11 pounds per gallon, and 35° Baumé is taken as the standard; dividing the weight of the sirup by 11 gives the number of standard gallons; multiplying the price that is to be paid for 11-pound sirup by the relative value figure, and dividing by 100, gives the price to be paid per standard gallon.

"*Example:* If 75 cents a gallon is to be paid for 11-pound

sirup, how much should be paid for 671 pounds of sirup testing 31° by the Baumé hydrometer?

671 ÷ 11 = 61 standard gallons.

75 × 88 ÷ 100 = 66 cents per gallon.

61 × 66 = $41.26, price to be paid."

WEIGHT OF SUGAR OBTAINED FROM 100 LBS. OF MAPLE SIRUP

Weighing 11 lbs. to the Gallon, when Sugared Off at Different Temperatures. (Cooke and Hills.)

Temperature of Sugaring Off.	Aver. Weight of Sugar.	Highest Weight of Sugar.	Lowest Weight of Sugar.	Temperature of Sugaring Off.	Aver. Weight of Sugar.	Highest Weight of Sugar.	Lowest Weight of Sugar.
° Fahr.	Lbs.	Lbs.	Lbs.	° Fahr.	Lbs.	Lbs.	Lbs.
232	82.7	82.0	83.3	238	79.5	78.5	80.7
233	81.9	80.5	82.8	239	79.2	78.4	80.3
234	81.2	80.0	81.9	240	78.7	78.2	79.7
235	80.8	79.5	81.6	241	78.5	77.9	79.3
236	80.5	79.5	81.1	242	78.1	77.4	78.9
237	80.0	79.0	80.9				

SORGHUM SIRUP OBTAINED FROM JUICE OF DIFFERENT DENSITIES.

(Cleland.)

Density of Juice.	Gal. Sirup Obtained from	Density of Juice.	Gal. Sirup Obtained from
6°	10 gal. juice.	8.5°	7 gal. juice.
6.5°	9 " "	9°	6.5 " "
7°	8.5 " "	10°	6 " "
7.5°	8 " "	11°	5.5 " "
8°	7.5 " "	12°	5 " "

Sorghum juice usually shows 8° to 10° density; thin semi-sirup is 20° density, heavy semi-sirup is 30°, hot finished sirup is 36° to 38°, and cold sirup about 40° density. (Wiley.)

TEMPERATURES TO WHICH PERISHABLE GOODS MAY BE SUBJECTED WITHOUT INJURY. (U. S. DEPARTMENT OF AGRICULTURE.)

Name of Article.	Lowest Outside Temperature: In Ordinary Pkgs. Unprotected.	In Ordinary Freight Cars.	In Refrigerator or Specially Prepared Cars.	Temperatures above which Injury Occurs.	Remarks.
	° F.	° F.	° F.	° F	
Apples, in bbls	20	10	−10	75	Covered with straw.
" loose	28	15	−10	75	Packed in straw.
Apricots, baskets....	35	24	10	70	
Asparagus.	28	22	....	70	In boxes covered with moss.
Bananas	50	32	..	90	Bulk or boxes with straw.
Beans, snap....... .	32	26	....	65	In barrels or crates.
Beets.	26	20	.	70	In crates.
Cabbage, early or late	25	20	zero	75	Barrels or crates.
Cantaloupes.	32	25	10	80	
Cauliflower	22	15	.. .	70	In barrels with straw.
Celery	10	zero	....	65	Packed in crates.
Cheese.	30	25	10	75	
Cranberries..	28	20	zero	...	
Cucumbers	32	20	...	65	In boxes with moss.
Eggs, bbl'd or crated	30	20	zero	80	
Fish.	10	zero	....	65	In barrels always iced.
Flowers.	35	20	−10	....	Packed in moss.
Grapes.	34	20	zero	....	Packed in cork.
Kale	15	zero	....	65	Packed in boxes or crates.
Leek	28	20	...	65	Packed in boxes.
Lemons.	32	20	10	75	In boxes or crates.
Lettuce.	26	15	....	70	In boxes or crates.
Mandarins......... ..	32	20	zero	75	In boxes.
Milk	32	28	zero	75	
Olives, in bulk.......	28	25	zero	.	In barrels.
" " glass	25	20	zero	....	
Onions, boxes...	20	15	zero	....	
Onions........... ...	20	10	....	80	In barrels, boxes, or crates.
Oranges......	28	20	zero	80	Baskets, boxes, bbls., or crates.
Parsley	32	20	....	75	In baskets.
Parsnips.....	32	20	. ..	70	In baskets or barrels.
Peaches, fresh, b'skets	32	20	10	80	
Peas.	32	20	.	80	In baskets or barrels.
Pineapples	32	25	zero	75	In barrels, crates, or in bulk.
Plums	35	32	zero	75	In boxes with paper.
Potatoes, Irish	35	25	10	80	In barrels or baskets.
" sweet	35	28	10	80	In barrels or baskets.
Radishes.	20	15	....	65	In baskets.
Rice.	20	10	..	90	In baskets or sacks.
Shrubs, roses, or trees	35	10	−10	..	In canvas or sacking.
Spinach.	15	15	....	75	In barrels or crates.
Strawberries........	33	25	−10	65	
Tangerines..	25	15	zero	70	In boxes.
Thyme.	20	10	...	90	In small baskets.
Tomatoes, fresh......	33	28	10	90	
Turnips, late.	15	zero	....	75	In barrels.
Watermelons	20	10	....	85	In barrels and in bulk.

TEMPERATURES INJURIOUS TO PLANTS.

(U. S. Dept. of Agriculture.)

The following table shows the temperatures at which the plants mentioned are liable to receive injury from frost. The temperatures are, as nearly as possible, those of the air in contact with the plant itself.

Plant or Fruit.	In Bud.	In Blossom.	In Setting Fruit.	At Other Times.
Almonds	28	30	30	28
Apples	27	29	30	26
Apricots	30	31	32	30
Asparagus	29	29	29	26
Bananas	31	31	32	31
Barley	....	29	....	....
Beans	....	31	....	....
Beets	....	....	....	25
Cabbage	....	....	....	15–27
Cantaloupes	32	32	....	30–31
Cauliflower	....	....	....	20–27
Celery	....	....	....	28
Cucumbers	31	31	31	32
Cymlings or squash	31	31	31	30
Flowers *	31	31	31	30
Grapes	31	31	30	28
Grape-fruit	30	31	31	28
Lemons	30	31	31	28
Lettuce	....	....	....	12–28
Mandarins	31	31	31	28
Oats	31	....	....	....
Okra	....	....	....	31
Olives	30	31	31	18‡ 24§
Onions	....	....	....	29
Oranges †	30	31	31	26‡ 29§
Parsnips	....	....	....	27
Peaches	29	30	30	29
Pears	28	29	29	28
Peas	29	30	30	25
Plums	30	31	31	29
Potatoes: Irish	30	30	30	31
Sweet	31	31	31	31
Prunes	30	31	31	29
Radishes	....	....	....	25
Shrubs, trees, or roses	26–30	28–32	....	30–26
Spinach	....	....	....	21
Strawberries	28	28	28	30
Tangerines	31	31	31	28
Tomatoes	31	31	31	31
Turnips	....	....	....	26
Watermelons	....	....	....	28–31
Wheat	....	31	31	....
Walnuts, English	30	31	31	28

* Depends on variety. † Injured at 2 higher if continued 4–6 hours.
‡ Ripe. § Green.

BEST TEMPERATURES FOR PRESERVING HORTICULTURAL PRODUCTS.

(Faville and Hall.)

Product.	Temperature, Degrees.	Package.	Time.
Apples, summer......	38 to 42	Barrels or boxes.	2 to 4 months.
Apples, winter... ...	32 to 35	" "	5 to 8 months.
Pears..............	33 to 38	" "	2 to 4 months.
Peaches..............	36 to 38	Crates.	2 to 4 weeks.
Grapes..............	38 to 40	In sawdust, in boxes.	6 to 8 weeks.
Plums..............	38 to 40	Crates.	2 to 4 weeks.
Berries and cherries..	40	Quart boxes.	1 to 3 weeks.
Bananas	40	Crates.	8 to 12 weeks.
Lemons, oranges.....	40	"	8 to 12 weeks.
Figs, raisins.........	40	Boxes.	8 to 12 weeks.
Watermelons	40	....	3 to 6 weeks.
Muskmelons	40	....	2 to 3 weeks.
Tomatoes...........	38 to 42	Crates.	2 to 4 weeks.
Cucumbers..........	38 to 40	"	1 to 3 weeks.
Celery	35	Boxes.	....
Cranberries.........	34 to 38	Barrels.	....
Onions........	34 to 40	"	....
Potatoes.............	36 to 40	"	....
Asparagus, cabbage..	34	Boxes.	... .

THE PRESERVATION OF SOFT FRUITS FOR EXHIBITION PURPOSES.

(Department of Agriculture, Ottawa, Canada.)

To preserve strawberries, raspberries, and other soft fruits, the following mixtures are recommended. The alcohol is not necessary except where the bottles will be exposed to frost. The chemicals mentioned in the list may be obtained at any drugstore.

General Directions.—Select the finest specimens of the fruit both as to form and size. Handle them carefully to avoid all bruising, and place them in bottles, arranging the specimens so as to show them to the best advantage. Fill each bottle to the neck with fruit, then pour on the fluid recommended, filling the bottles to within half an inch of the stopper so as to entirely cover the fruit. Then place the stopper in the bottle and run a little beeswax or paraffin over the joint to make it air-tight. Tie the stopper down with a piece of strong cotton and attach to each bottle

a label containing the following particulars: Name of the variety of fruit, name and address of the grower. Write also in each case in one corner of the label the letter suggested to indicate the fluid which has been used. Wrap the bottles in paper to exclude the light, and preserve in a cellar or other cool place until required for shipment. Strawberries and raspberies should be cut from the plants or bushes with a pair of scissors, leaving a short piece of stem attached to each.

FLUID NO. 1.—Formalin (formaldehyde), one pound (16 oz.); water, 44 pounds; alcohol, 5 pints. Allow the mixture to stand, and should there be any sediment, pour off the clear liquid and filter the remainder through filtering-paper. This two-per-cent. solution of formalin has been found very useful for preserving strawberries so as to give them a natural appearance.

In each case where this fluid is used, mark F on one corner of the label.

FLUID NO. 2.—A solution of boric acid in the proportion of two per cent. Dissolve one pound of boric (boracic) acid in 45 pounds of water, agitate until dissolved, then add 5 pints of alcohol. If the fluid is not clear, allow it to stand and settle, when the clear upper portion may be poured off and the remainder filtered.

In each case where this fluid is used, mark B on one corner of the label.

FLUID NO. 3.—A solution of zinc chlorid in the proportion of three per cent. Dissolve one-half pound of zinc chlorid in 15 pounds of water, agitate until dissolved, then add 1⅞ pints of alcohol. Allow the mixture to stand until settled, then pour off the clear fluid and filter the remainder.

In each case where this fluid is used, mark Z on one corner of the label.

FLUID NO. 4.—Sulfurous acid, 1 pint; water, 8 pints; alcohol, 1 pint. Allow the mixture to stand, and should there be any sediment, pour off the clear liquid and filter the remainder.

In each case where this fluid is used, mark S on the corner of the label.

List of Fruits with the Names of Preservatives to be Used in Each Case.

(Where two fluids are named either may be used, but the first named is preferred.)

Strawberries.—Solution No. 1, formalin
Raspberries, Red.—No. 2, boric acid; No. 1. formalin.
Raspberries, White.—No. 4, sulfurous acid; No. 3, zinc chlorid.
Raspberries, Black.—No. 2, boric acid.
Blackberries.—No. 2, boric acid; No. 1, formalin.
Cherries, Red and Black.—No. 1, formalin; No. 2, boric acid.
Cherries, White.—No. 4, sulfurous acid.
Currants, Red.—No. 1, formalin; No. 2, boric acid.
Currants, White.—No. 4, sulfurous acid; No 3, zinc chlorid.
Currants, Black.—No. 2, boric acid.
Gooseberries.—No. 1, formalin; No. 2, boric acid.
Apples, Green and Russet.—No. 3, zinc chlorid.
Apples, more or less Red.—No. 2, boric acid.
Apples, White and Yellow.—No. 4, sulfurous acid.
Pears, Russet.—No. 3, zinc chlorid.
Pears, Green or Yellow.—No 4, sulfurous acid.
Plums, dark-colored varieties.—No. 1, formalin; No. 2, boric acid.
Plums, Green or Yellow.—No. 4, sulfurous acid.
Peaches, Apricots, Nectarines, or Quinces.—No. 4, sulfurous acid; No. 3, zinc chlorid.
Grapes, Red or Black.—No. 1, formalin; No. 2, boric acid.
Grapes, Green or Yellow.—No. 4, sulfurous acid.

THE STANDARDS OF THE BALTIMORE CANNED GOODS EXCHANGE. (Pa. Dept. of Agriculture.)

A. FRUITS.

Apples.—Pared and cored, clear in color; cans to be full of fruit, put up in water.

Blackberries.—Cans to cut out not less than two-thirds full after draining; fruit to be sound, put up in water.

Cherries, White Wax.—Cans to be full of fruit, free of specks and decay, put up in not less than ten degrees of cold cane-sugar syrup.

Cherries, Red.—Cans full of fruit, free of specks or decay, put up in water.

Gooseberries.—Cans to cut out not less than two-thirds full after draining; fruit unripe and uncapped; put up in water.

Egg Plums and *Green Gages.*—Cans full, whole fruit, free from reddish color or specks, put up in not less than ten degrees of cold cane-sugar syrup.

Peaches.—Cans full, fruit good size, evenly pared, cut in half pieces, put up in not less than ten degrees of cold cane-sugar syrup.

Pie Peaches.—Cans full, fruit sound, unpared, cut in half pieces, put up in water.

Pears. Bartlett.—Cans full, fruit white and clear, pared, cut in

half or quarter pieces, put up in not less than ten degrees of cold cane-sugar syrup.

Pears, Bell or Duchess.—Cans full, fruit pared, cut in half or quarter pieces, put up in not less than ten degrees of cold cane-sugar syrup.

Pineapples.—Cans full, fruit sound and carefully pared, slices laid in evenly, put up in not less than ten degrees of cold cane-sugar syrup.

Plums and *Damsons.*—Cans full, sound fruit, put up in water.

Quinces.—Cans full, fruit pared and cored, cut in half or quarter pieces, put up in not less than ten degrees of cold cane-sugar syrup.

Raspberries.—Cans to cut out not less than two-thirds full and after draining, fruit to be sound, put up in not less than ten degrees of cold cane-sugar syrup.

Strawberries.—Cans to cut out after draining not less than half full of fruit, which shall be sound, and not of the variety known as seedlings, put up in not less than ten degrees of cold cane-sugar syrup.

Whortleberries.—Cans full, fruit to be sound, put up in water.

B. Vegetables.

Lima Beans.—Cans full of green beans, clear liquor.

String Beans.—Cans full, beans young and tender and carefully strung, packed during growing season.

Corn.—Sweet corn only to be used from the cob while young and tender, cans to cut out full of corn.

Peas.—Cans full of young and tender peas, free of yellow or black eyes, clear liquor.

Pumpkin.—To be solid packed as possible, free from lumps and of good color.

Succotash.—Cans to be full of green corn and green lima beans.

Tomatoes.—Cans to be reasonably solid, of good, ripe fruit, cold packed.

STANDARD SIZES FOR CANS.

	Diameter.	Height.
No. 1 Cans......	$2\frac{3}{4}$ in.	4 in.
No. 2 Cans......	$3\frac{7}{16}$ "	$4\frac{9}{16}$ "
No. 3 Cans	$4\frac{3}{16}$ "	$4\frac{7}{8}$ "

	Diameter.	Height.
No. 6 Cans, twice the quantity of No. 3.		
No. 10 Cans	$6\frac{1}{4}$ in.	7 in.

VI. SEEDS.

SEED-TESTING FOR THE FARMER.

By the late Gilbert H. Hicks, of U. S. Department of Agriculture.*

Not less important than good soil and suitable cultivation is seed of the best obtainable quality. In no feature of farm practice is niggardly economy or lack of proper attention more productive of disappointment and loss than in the failure to provide proper seed for sowing. The market gardener is fully alive to this fact, and makes the purchase of desirable seed his foremost care. He wants not only seed which will grow, but also that which will produce an even stand and yield a large crop of the very best vegetables. The matter of paying a few cents or even a dollar extra per pound is to him of no significance, since he knows by long experience that the increased value of his crop will far outweigh the extra cost of the seed.

With many farmers this care in the selection of seed is often lacking. Frequently the land is all tilled and ready for sowing before the seed is bought. It is then too late to give it a careful preliminary test, even if the owner desired to do so. This results very often in a poor stand, perhaps in a failure of the crop, or in the scattering of hordes of weeds all over the farm, which usurp the place of the cultivated plants, and cost infinite trouble in their eradication. This is especially noticeable in the case of the clovers, grasses, and other forage plants. No matter how poor the seed turns out to be, after once sown it is too late to secure any redress from the seedsman. Besides, there are very few places in this country where one can get seed tested in order that its real value may be ascertained before sowing. It becomes, then, a matter of great importance to the farmer to provide himself with some simple but efficient means for testing his seed before it is sown.

All seed which is to be used for spring sowing should be procured whenever possible in the previous fall or winter.

* Revised by A. J. Pieters, late Botanist in Charge of Seed and Plant Introduction, U. S. Department of Agriculture.

The long winter months will give ample opportunity for close examination of the seed, and if any of it be found of inferior quality, as will not infrequently prove to be the case, there will be plenty of time to replace it with a desirable article. In all cases seed should be bought of the most reliable seedsmen. In many instances it will pay to get seed from the large dealers, as they have first-class opportunities for handling the very best seed in the country. The extra cost for carriage will be a small item compared with the chance for obtaining good seed.

No matter from what source the seed is obtained, nor how reliable the dealer, every farmer should test each lot of seed he expects to plant. Besides learning its quality, he will often obtain valuable information concerning the depth, temperature, and amount of moisture needed, etc. Furthermore, if the seed fails to come up well, the planter will have some intelligent data for ascertaining the reason, and will not be obliged to depend entirely upon the statement of seed catalogues, which convey the impression that failure to germinate is more likely to be the fault of the outdoor conditions than of the seed itself.

Good seed is marked by three characteristics: *purity*—or freedom from foreign matter, whether seeds of weeds or other plants; *vitality*—or capacity for sprouting under favorable conditions; and *genuineness*—or trueness to name. If any of these qualities be lacking, the seed is unworthy of general trial.

Purity.—Most vegetable seeds, especially if grown in America, are quite free from admixture. Seed of the cabbage family, however, if grown abroad, and sometimes that of American origin, may contain a mixture of wild mustard or similar seed, often so near like the good seed as to be almost indistinguishable from it.

Clover and grass seed is very likely to contain more or less seed of noxious weeds or inferior grasses; hence a careful purity test is necessary in such cases. Hairy vetch and other leguminous forage seeds, excepting the clovers, generally come from Europe and are frequently impure. Often it will require considerable care to detect impurities

in the seeds of forage plants, and in case of any doubt samples of such seed should be sent to the nearest experiment station or to the Department of Agriculture for examination.

Purity tests are usually made by weighing out a few ounces of seed which has been well stirred up so as to make the sample uniform. This seed is placed upon a pane of glass under which is a piece of light-colored paper, and the sample is carefully gone over seed by seed with a small forceps until all the impurities are separated out. After again weighing, the percentage of impurity is easily obtained. If the impurity consists of chaff or dirt, the loss will consist only in paying for something which will not grow. This will render necessary the sowing of more than the usual amount of seed to the acre. If weed seeds are present, there will be greater or less loss according to the character of the weeds. Such seeds as Canada thistle, dodder, Russian thistle, chess, wild mustard, cockle, plantain, black medic, daisy, penny-cress, wild carrot, wild oats, and a few others, are serious pests. Every farmer should be able to recognize these weed seeds, and avoid all seed which contains any of them even in small amounts. He should also be familiar with the ordinary grass seeds of trade, such as June grass, orchard grass, the common fescues, red top, tall meadow oat grass, etc. Grass-seed mixtures almost invariably contain a large proportion of seed of inferior, if not worthless, species, dirt, and chaff, and should be avoided. It is much better to find out what grasses are adapted to one's fields or pastures and to buy such seed separately, mixing it at home.

If scales are not at hand, the amount of pure seed in a given sample can be approximately learned by placing the pure seed in a small bottle with the impurities in another bottle of similar shape and size. The names of the foreign seeds may be learned from some botanist or experiment station.*

* The following *standards of purity* are adopted by the U. S. Department of Agriculture:

Asparagus, beans, buckwheat, cabbage, cauliflower, celery,

After determining the per cent of pure seed in a sample, the *germinative ability* should be ascertained. This is even more important. One can judge fairly well of the purity of seed by a casual inspection, but no one can tell by its looks whether a seed is capable of sprouting or not. Considering the great amount of labor and expense involved, it is surprising that so few farmers test their vegetable and field seeds before they are sown.

Even fresh seed is sometimes incapable of germination through improper care in harvesting or cleaning. Nor can fresh seed be told by its appearance with certainty. Add to this the fact that old seed is frequently offered for sale, and there is no lack of reason for testing the sprouting capacity of the seed one intends to sow.

If the heat and moisture are properly controlled, seed-testing will be found a very simple matter. Seventy to eighty degrees Fahrenheit must be maintained during the day, with a fall of not more than twenty degrees at night, and the seed must be kept constantly damp, but not wet. A good plan is to plant a hundred seeds of average quality —that is, an average number of large, small, plump, and shrivelled ones, etc.—in moist soil in a box or in a small flower-pot which is set inside of a large pot also containing soil. Water as needed is added from time to time in the larger pot and the whole is kept covered so as to prevent evaporation and sudden cooling. When the seeds begin to come up, the pots should be exposed to the light. After about two weeks for most seeds the seedlings are counted and the percentage of sprouts ascertained. If the soil has been previously heated to kill all weed seeds, and proper precautions have been taken, such a test will give a good indication of the value of the seed. To make sure, a dupli-

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collards, Indian corn, cow pea, cucumber, eggplant, lettuce, melon, millet (common and pearl), oats, okra, onion, peas, pumpkin, radish, rutabaga, salsify, squash, tomato, turnip, vetch (hairy)	99 per cent.
Alfalfa, beets, crimson clover, red clover, cotton, Kafir corn, parsley	98 " "
Parsnip	97 " "
Hungarian brome grass, carrot, white clover, alsike clover	95 " "
June grass, poa compressa	90 " "

cate lot of one hundred seeds should be tested at the same time under the same conditions and the results compared. If the variation exceeds ten per cent, the tests should be repeated until the source of error is discovered. Grasses and very fine seed will require more care than other kinds. Such seed should be barely covered with soil, while in all cases too deep planting must be avoided. In testing grass seeds, except timothy, care must be taken that the heavier chaff, which looks like good seed, but does not contain a grain, is not counted with the good seed. Every seed should be gently pressed with the finger-nail or with a small penknife to determine whether or not it contains a grain. The chaff should count as impurity, but should not be tested for germination. Some hard-coated seeds may be soaked a few hours in warm water, but as a usual thing it is better not to do so.

Seeds of clovers and most vegetables can be easily germinated between two folds of damp flannel cloth placed between two plates. Such tests permit frequent inspection of the seed, which should be thrown away as fast as it germinates, count being kept of the same. Damp blotters, porous dishes, and various kinds of especially prepared germinating apparatus are sometimes used in seed-testing. The amount of moisture to be given varies greatly with the variety of seed and can be best learned by experience. In general, quick-sprouting seeds, like clover, cabbage, radish, etc., will stand more moisture than those varieties which sprout more slowly.

To make sure of the vitality of seed it is better to test it in the soil, as previously suggested, and also by the cloth or plate method. Soil tests should be continued a few days longer than those made between cloth or blotters. There is considerable difference of opinion as to the standards of germination to which first-class seed should attain. Those in use at present by the U. S. Department of Agriculture are given in the first table on page 109. While first-class seeds should reach the standards referred to, it may be said that seed which falls as much as ten per cent below them need not be rejected as bad.

TABLE OF GERMINATION STANDARDS.

(U. S. Dept. of Agriculture.)

Seed.		Seed.		Seed.	
Asparagus	85	Cucumber	90	Okra	90
Beans, bush	95	Egg-plant	80	Onion	85
" lima	95	Endive	94	Parsley	75
Beet	150	Gherkin	92	Parsnip	75
Borecole	95	Grasses:		Peas	98
Broccoli	85	Canada blue	50	Pepper	85
Brussels sprouts	95	Fowl meadow	75	Pumpkin	90
Buckwheat	95	Johnson	75	Radish	95
Cabbage	95	Hungarian brome	80	Rape	95
Carrot	85	Kentucky blue	50	Rhubarb	85
Cauliflower	85	Meadow fescue	80	Rutabaga	95
Celeriac	65	Orchard	80	Salsify	83
Celery	65	Texas blue	50	Sorghum	90
Chicory	85	Timothy	90	Spinach	89
Clover, alfalfa	90	Kafir corn	90	Spurry	90
" alsike	80	Kohl-rabi	90	Squash	90
" red	90	Leek	85	Sunflower	90
" scarlet	95	Lettuce	90	Tobacco	88
" white	80	Lupin, yellow	90	Tomato	90
Collards	95	Melon	90	Turnip	95
Corn	90	Millet, common	90	Vetch, hairy	90
Cotton	90	" pearl	90	Wheat	95
Cowpea	90	Mustard	95		
Cress	90	Oats	90		

NUMBER, WEIGHT, COST OF GRASS SEEDS, AND AMOUNT TO SOW PER ACRE.

(Yearbook U. S. Dept. of Agriculture.)

[Columns 1, 2, 3, and 4 are compiled from "The Best Forage Plants," by Stebler and Schroeter. The figures in column 5 are obtained by multiplying the amount of standard quality of seed required (col. 2) by the retail price quoted in N. Y. catalogues. The weight of 10,000,000 grains (col. 6) is obtained by dividing this quantity by the number of seeds in one pound (col. 1).]

No.	Name.	(1) Number of Grains per lb. of Pure Seed.	(2) Amount to Sow per Acre in lbs., Standard Quality.	(3) Amount to Sow per Acre in lbs. of Pure Germinating Seed.	(4) Weight per Bushel, lbs.	(5) Cost of Seed per Acre.	(6) Weight of 10,000,000 Grains, lbs.
1	Redtop (Agrostis alba)	603,000	9.7	7.00	8–32	$1.45	16.58
2	Reed canary grass (Phalaris arundinacea)	660,000	21.0	12.00	44–48	7.35	15.15
3	Smooth-stalked meadow grass (Poa pratensis)	2,400,000	17.5	8.40	12–20	2.10	4.17
4	Rough-stalked meadow grass (Poa trivialis)	3,000,000	19.5	8.75	11–17	4.88	3.33

NUMBER, WEIGHT, COST OF GRASS SEEDS, AND AMOUNT TO SOW PER ACRE—*Continued.*

No.	Name.	(1) Number of Grains per lb. of Pure Seed.	(2) Amount to Sow per Acre in lbs., Standard Quality	(3) Amount to Sow per Acre in lbs of Pure Germinating Seed	(4) Weight per Bushel, lbs.	(5) Cost of Seed per Acre.	(6) Weight of 10,000,000 Grains, lbs.
5	Sheep's fescue (Festuca ovina)	680,000	28 0	12.60	10-15	$4.20	14.85
6	Various-leaved fescue (Festuca heterophylla)	400,000	33.5	19 50	....	8.38	25 00
7	Creeping fescue (Festuca rubra)	600,000	42 5	13.00	10-15	8.50	16.67
8	Awnless brome grass (Bromus inermis)	137,000	44 0	35.60	10-14	8.80	72.99
9	Perennial rye grass (Lolium perenne)	336,800	55.0	38.50	18-30	4.95	29.70
10	Italian rye grass (Lolium italicum)	285,000	48.5	32.40	12-24	3.56	35.10
11	Orchard grass (Dactylis glomerata)	579,500	35.0	....	12-16	5.60	17.25
12	Meadow fescue (Festuca pratensis)	318,200	52.0	....	12-26	7.80	31.42
13	Meadow oat grass (Arrhenatherum avenaceum)	159,000	70.0	34.30	10	12.60	62.89
14	Yellow oat grass (Trisetum flavescens)	2,045,000	29.0	4.64	5.5	24.65	4.89
15	Velvet grass (Holcus lanatus)	1,304,000	22.0	8.80	6.5	4.40	7.66
16	Timothy (Phleum pratense)	1,170,500	16.0	14.00	48	1.50	8.54
17	Meadow foxtail (Alopecurus pratensis)	907,000	23.0	6.21	6	6.21	11.02
18	Vernal grass (Anthoxanthum odoratum)	924,000	30.0	7.80	......	15.00	10 82
19	Crested dog's tail (Cynosurus cristatus)	1,127,000	25.0	13.50	20-32	7.50	8.87
20	Alsike clover (Trifolium hybridum)	707,000	12.3	9.00	94-100	1.60	14.14
21	Sainfoin (Onobrychis sativa)	22,500	78.0*	60.84*	40	6.25	444 44
22	Red clover (Trifolium pratense)	279,000	18.0	15.84	64	2.50	35.84
23	White clover (Trifolium repens)	740,000	10.5	7.50	63	2.94	13.51
24	Common kidney vetch (Anthyllus vulneraria)	154,000	17.5	15.00	60-64	4.58	67.15
25	Alfalfa, or lucern (Medicago sativa)	209,500	25.0	22.00	61-63	3.25	48.56
26	Trefoil (Medicago lupulina)	328,000	18.0	14.75	64-66	2.16	30.48
27	Bird's-foot trefoil (Lotus corniculatus)	375,000	11.0	4.67	60	4.40	26.66
28	Officinal goat's rue (Galega officinalis)	62,000	22.0	6.90	......	4.14	161.29

* Unshelled.

NOTES ON ADAPTABILITY AND USES OF PRECEDING GRASSES AND CLOVERS.

No. 1. Requires moist climate or damp soil. Best propagated by transplanting small turf cuttings in autumn. Valuable for late pasturage or lawns in the New England and Middle States. Use 5–10 per cent in mixtures.

No. 2. Adapted to stiff, wet lands and flooded fields. Requires moisture. Valuable hay when cut young, and well suited for binding loose banks near running water or for forming a firm sod on marshy ground.

No. 3. Grows best on strongly calcareous soils. Well adapted for pasture, and makes a good bottom grass for meadows. An excellent lawn grass.

No. 4. Should be sown only on moist, fertile, and sheltered soils in mixtures.

No. 5. Light, dry soils, especially those which are poor, shallow, and silicious. Valuable bottom grass and for sheep pastures. Sown only in mixtures.

No. 6. Best on moist, low lands containing humus and sandy loams. Withstands drought; useful in pasture; unimportant for hay. Alone it makes no continuous turf.

No. 7. Valuable pasture or bottom grass. Withstands drought; endures both cold and shade. On poor land, especially moist sands and railway banks, serves to bind the soil. Product small.

No. 8. Valuable for light soils, especially in regions subject to extremes of heat or long periods of drought. Used alone or in mixtures for permanent meadows and pastures.

No. 9. Excellent and lasting pasture grass for heavy soils in moist, cool climates. On light, dry soils disappears after the second year. Rarely sown alone.

No. 10. Excellent for rich and rather moist lands. Regarded in Europe as one of the best for hay. Lasts only two or three years.

No. 11. Grows well on any soil, excepting that which is very wet; withstands shade. Affords a large amount of aftermath. Valuable alike for hay and pasturage.

No. 12. Thrives in either dry or wet soils. Valuable hay or pasture grass.

No. 13. Thrives on moist, loamy sands or light clays which are not too moist, and marls. Spring most favorable seed-time. Valuable in the South for hay and winter pasture.

No. 14. Valuable for temporary or permanent pastures. Thrives on marly or calcareous soil, in all light land rich in humus.

No. 15. Sometimes sown on light, thin soils unsuited for more valuable sorts. Rarely used excepting in mixtures.

No. 16. Best known and most extensively cultivated for hay. Sown alone or mixed with redtop or clover. Succeeds best on moist loams or clays. On dry ground the yield is light.

No. 17. Endures cold. Likes strong soil, stiff loam, or clay. One of the best grasses for land under irrigation. Very early. Two to four pounds in mixtures for permanent pastures.

No. 18. Grows on almost any kind of soil; sown only in mixtures, 1 to 2 pounds, with permanent pasture or meadow grasses.

No. 19. Especially adapted for loams, light clays, marls, and moist, loamy sands. Moist climates are most suitable. Withstands drought and thrives well in shade. Nutritive value high. Used in mixtures to form bottom grass either in pasture or hay.

No. 20. Grows on strongest clay or peaty soil: peculiarly adapted to damp ground. Bears heavy frosts without injury. Sown in August or February.

No. 21. Requires good and open subsoil, free from water. Sown alone, from end of March to beginning of May.

No 22. Succeeds best in rich, loamy soil, on good clays, and on soils of an alluvial nature. A standard fodder plant.

No. 23. Thrives on mellow land containing lime, and on all soils rich in humus. Resists drought. Generally used in mixtures for pastures or lawns.

No. 24. Cultivated for grazing; on warm soils, if manured

and of proper depth. Hardy; resists drought. Sheep, goats, and horned cattle eat it greedily.

No. 25. Grows well on any calcareous soil having a permeable subsoil. Especially adapted to the warm and dry regions of the West and Southwest. Requires irrigation.

No. 26. Any soil containing sufficient moisture and lime is suitable. Most successful on clay marls. Cultivated only where the better kinds of clover cannot be grown.

No. 27. Thrives on dry or moist, sandy or clayey soils. Well suited to dry lands at high elevations, though poor.

No. 28. Excellent fodder plant for warm, sheltered situations. Thrives only in deep soil, and when subsoil is not wet.

VITALITY OF SEEDS IF PROPERLY KEPT.

(McKerrow.)

Turnips	5	years	Wheat	2	years
Rape	5	"	Buckwheat	2	"
Pumpkin	5	"	Corn	2	"
Peas	3	"	Timothy	2	"
Beans	3	"	Rye	2	"
Clover	3	"	Flax	2	"
Oats	3	"	Millet	2	"
Barley	3	"	Orchard-grass	2	"

SEEDSMEN'S CUSTOMARY WEIGHTS PER BUSHEL OF SEEDS. (E. Brown.)

Kind of Seed.	Pounds per Bushel.
Alfalfa	60
Amber cane	45–60
Bent grass:	
Creeping	10–20
Rhode Island	10–15
Bermuda grass	24–36
Bird's-foot clover	60
Bitter vetch	60
Blue grass:	
Canada	14–20
Kentucky	14–30
Texas	14
Broad bean	50–60
Brome, awnless	10–14
Broom corn	45–60
Bur clover:	
Hulled	60
Unhulled	8–10
Spotted	60
Castor bean	46–60
Clover:	
Alsike	60
Crimson	60
Egyptian	60
Mammoth	60
Red	60
White	60
Cowpea	56–60
Crested dog's tail	14–30
Fescue:	
Hard	12–16
Meadow	14–24
Red	12–15
Sheep's	12–16
Tall	14–24
Various leaved	14–18
Flat pea	50–60
Flax	48–56
Hemp	40–60
Japan clover:	
Hulled	60
Unhulled	18–25
Johnson grass	14–28
Kafir corn	50–60
Lentil	60
Lupine, white	50–60
Meadow foxtail	7–14
Meadow grass:	
Fowl	11–14
Rough stalked	14–20
Wood	14–24
Millet:	
Barnyard	30–60
Broom corn	45–60
Common	48–50
German	48–50
Golden wonder	48–50
Hungarian	48–50
Pearl	48–56
Milo maize	50–60
Oat grass:	10–14
Tall	7–14
Yellow	45–60
Orange cane	
Orchard grass	10–18
Pea:	
Field	60
Garden, smooth	60
Garden, wrinkled	56
Peanut	20–30
Rape, winter	50–60
Red top:	
Chaff	10–14
Fancy	25–40
Rescue grass	12–28
Rice	43–45
Rye grass:	
English	10–30
Italian	14–25
Sainfoin	14–32
Serradella	28–36
Soy bean	58–60
Spelt	40–60
Sunflower	24–50
Sweet clover:	
Hulled	60
Unhulled	33
Sweet corn (acc. to var.)	36–56
Sweet vernal, perennial	6–15
Teosinte	40–60
Timothy	45
Velvet bean	60
Vetch:	
Hairy	50–60
Spring	60
Water grass, large	14
Wild rice	15–28
Yellow trefoil	60

WEIGHT AND SIZE OF GARDEN SEEDS.

(VILMORIN.)

Name.	Wt. of a Qt. of Seeds, Oz.	No. of Seeds in a Grain.	Name.	Wt. of a Qt. of Seeds, Oz.	No. of Seeds in a Grain.
Anise	11.7	13	Leek	21.4	26
Asparagus bean	29.9	32–42	Lettuce	16.7	52
Bean	24.3	*5	Maize	24.9	†2–3
Beet	9.7	3	Muskmelon	14.0	4
Borecole	27.2	19	Mustard, black	26.2	45
Broccoli	27.2	24	white	29.1	13
Cabbage	27.2	19	Nasturtium, tall	13.2	†4–5
Caraway	16.3	23	dwarf	23.3	1
Carrot:			Okra	24.1	†10–12
With spines	9.3	45	Onion	19.4	16
Without spines	14.0	62	Pea	27.2–31.1	†1–4
Cauliflower	27.2	24	gray or field	26.4–31.1	†3–5
Celery	18.6	162	Peanut	15.5	†1–2
Chicory	15.5	45	Pepper	17.5	10
Cress, American	21.0	62	Pumpkin	9.7	†2
com. garden	28.4	29	Purslane	23.7	162
Cucumber, com.	19.4	2	Radish	27.2	8
globe	19.4	6	Rhubarb	3.1–4.7	3
snake	17.5	3	Salsify	8.9	6
Dill	11.7	58	Spinach	19.8	7
Eggplant	19.4	16	Squash	16.7	6
Endive	13.2	39	Tomato	11.7	19–26
Gourds, fancy	17.5	1	Turnip	26.0	29
Hop	9.7	13	Watermelon	17.9	†3–4
Kohlrabi	27.2	19			

* In 100 grains. † In 10 grains.

AVERAGE TIME REQUIRED FOR GARDEN SEEDS TO GERMINATE. (BAILEY.)

Name.	Days.	Name.	Days.	Name.	Days.
Bean	6–10	Corn	5–8	Parsnip	10–20
Beet	7–10	Cucumber	6–10	Pepper	9–13
Cabbage	6–10	Endive	5–10	Radish	3–6
Carrot	12–18	Lettuce	6–8	Salsify	7–12
Cauliflower	6–10	Onion	7–10	Tomato	6–12
Celery	10–20	Pea	6–10	Turnip	4–8

YIELD OF SEEDS FROM AN ACRE. (BAILEY.)

	Good Crop (= 20 bu. Wheat).	Maximum Crop (= 50 bu. Wheat).	Yield Seedsmen would Figure in Making Contracts for Large Quantities.
Bean	600 lbs.	1500 lbs.	500 lbs.
Cabbage (2 years)	250	800	200
Cucumber	150	700	100
Muskmelon	125	600	100
Pea	900	2500	800
Squash, winter	100	400	100
" summer	100	700	100
Sweet corn	1000–2500 (acc. to var.)	2500–4000	800–2000
Tomato	100	400	100
Watermelon	150	1000	100

VII. WEEDS.

TABLE OF NOXIOUS WEEDS.*

By L. H. Dewey, Assistant Botanist U. S. Department of Agriculture.

Note 1.—The table presents the common and technical name, with some of the characteristics, of fifty-five weeds which are regarded as the most troublesome in the United States.

Note 2.—By alternate cultivation and smothering crops is meant clean cultivation during the dry season and a heavy seeding of some annual crop, as crimson clover, cowpeas, millet, or oats, that will cover the ground thickly and choke down the weeds during the growing season.

Note 3.—[1] Annual plant; [2] biennial plant; [3] perennial plant.

Common Names.	Technical Name.	Where Injurious.	Time of Seeding.	Methods of Propagation and Distribution of Seed.	Place of Growth and Products Injured.	Methods of Eradication.
Barnyard grass, cocksfoot.	Echinochloa crus-galli.[1]	Minn. to Mon.	July to Sept.	Seeds; in grain seed.	Fields; spring wheat.	Prevention of seeding.
Bindweed, morning-glory.	Convolvulus arvensis.[3]	Me. to Kan. and Cal.	Aug. to Oct.	Seeds; running roots.	Grainfields; hoed crops.	Clean clutivation; spudding.
Black mustard.	Brassica nigra.[1]	Wash. to Cal.	July to Oct.	Seeds; in grass and grain seed.	Fields; grain crops.	Prev. of seeding; hoed crops.
Buffalo bur, beaked horse nettle.	Solanum rostratum.[1]	Ia. to Colo.	July to Nov.	Seeds, tumbleweed.	Grain; hoed crops.	Heavy seeding; close cultiv.
Bull thistle, common thistle.	Carduus lanceolatus[2]	Me. to Mo.	do.	Seeds; wind.	Meadows: winter wheat.	Prev. of seeding; cutting in fall.
Burdock, great dock..	Arctium lappa.[2]	Me. to Wis.	Aug. to Oct.	Seeds: animals.	Waste places; pastures; wool.	Prev. of seeding; grubbing in summer.
Bur grass, hedgehog grass, sand bur.	Cenchrus tribuloides.[1]	Everywhere.	July to Nov.	do.	Sandy pastures; wool.	Cultiv., burning; dense crops.
Buttonweed, poorweed	Diodia teres.[1]	Md. to Ala.	do.	Seeds.	Waste places; hoed crops; grainfields.	Prev. of seeding; close cultivation.

Canada thistle, cursed thistle.	Carduus arvensis.[3]	Me. to Mich. and Ore.	July to Oct.	Seeds; wind; running roots.	Fields; grain; meadows.	Alternate cultiv. and heavy cropping; spudding.
Charlock, wild mustard yellow mustard.	Brassica arvensis.[1]	Me. to Ore.	June to Oct.	Seeds; in grain seed.	Fields; grain.	Prev. of seeding; copper sulfate; hoed crops.
Chess, cheat.	Bromus secalinus.[1]	Me. to Wash.	July to Aug.	do.	do.	Clean seed.
Clover dodder, devil's gut, dodder; lovevine	Cuscuta epithymum.[1]	N. Y. to N. C. and westw'd	June to Nov.	Seeds; in clover and alfalfa s'd.	Clover; alfalfa.	Clean seed; rotation of crops.
Cockle, corn cockle, rose campion.	Agrostemma githago.[1]	Me. to Wash.	July to Sept.	Seeds; in grain seed.	Grainfields; wheat.	Clean seed.
Cocklebur, clot bur. . .	Xanthium canadense.[1]	Everywhere.	Aug. to Nov.	Seeds; animals.	Waste places; pastures; wool.	Mowing; burning cultivation.
Corn, gromwell, wheat thief, pigeonweed, redroot.	Lithospermum arvense.[1]	Mich. to Ohio.	July to Oct.	Seeds; in grain seed.	Grainfields.	Sowing clean seed; cultiv. with hoed crops.
Couch grass, quack grass, witch grass, quick grass.	Agropyrum repens.[3]	Me. to Minn.	Aug. to Sept.	Rootstocks.	Fields; all crops except hay.	Alternate cultiv. and heavy cropping.
Curled dock, yellow dock.	Rumex crispus.[3]	Me. to Wash.	July to Oct.	Seeds.	Meadows; grain crops.	Alternate cultiv. and heavy cropping.
Dandelion.	Taraxacum taraxacum.[3]	All States.	May to Nov.	Seeds; carried by wind.	Meadows; pastures; lawns.	Cultiv.; digging roots in lawns.
Dog fennel, Mayweed. .	Anthemis cotula.[1]	Everywhere.	July to Sept.	do.	Roadsides.	Prev. of seeding.
Horse nettle, bull nettle, sand briar.	Solanum carolinense.[3]	Ia. to N. J. and south.	Aug. to Nov.	Seeds; running roots.	Waste land; meadows; pastures.	Alternate cultiv. and heavy cropping.
Horseweed, butterweed, colt's tail, fleabane.	Leptilon canadensis[1]	Everywhere.	July to Oct.	Seeds; wind.	Waste land; meadows; grainfields.	Prev. of seeding; late cultivation.
Hound's tongue, Gipsy flower.	Cynoglossum officinale.[2]	Me. to Minn.	July to Nov.	Seeds; burs in wool.	Pastures and meadows; wool.	Cultivation, pulling; mowing.

* Condensed and re-edited by the author from *Table of Two Hundred Weeds*, U. S. Dept. of Agriculture Yearbook, 1895.

TABLE OF NOXIOUS WEEDS—(*Continued*).

Common Names.	Technical Name.	Where Injurious.	Time of Seeding.	Methods of Propagation and Distribution of Seed.	Place of Growth and Products Injured.	Methods of Eradication.
Man-of-the-earth, morning-glory, wild potato vine.	Ipomœa pandurata.[3]	Del. to Mo.	Aug. to Oct.	Seeds; perennial roots.	Fields.	Prev. of seeding; killing roots with coal-oil.
Mexican tea, pigweed..	Chenopodium ambrosioides.[1]	Va. to La.	do.	do.	Waste places.	Prev. of seeding.
Milkweed, cottonweed, silkweed.	Asclepias syriaca.[3]	N. Y. to Neb.	Aug. to Sept.	Seeds; wind; running roots.	Fields.	Prev. of seeding; cultiv.; heavy cropping.
Narrow-leafed stick-seed, beggar tick.	Lappula lappula.[1]	Everywhere.	July to Oct.	Seeds; animals.	Everywhere; all crops.	Sowing clean seed; cultivation.
Nut grass, nut sedge, coco, coco sedge.	Cyperus rotundus.[3]	Va. to Tex.	Aug. to Nov.	Tubers; in nursery packing: seeds.	In hoed crops.	Alternate cultiv. and smothering crops.
Orange hawkweed, ladies' paint brush, red daisy.	Hieracium aurantiacum.[3]	N. Y. to Me.	Aug. to Oct.	Seeds; wind; rootstocks.	Meadows; pastures.	Prev. of seeding; cultivation; salt.
Ox-eye daisy, bull's-eye, white daisy, whiteweed.	Chrysanthemum leucanthemum.[3]	Me. to Va. and Ohio.	July to Oct.	Seeds; rootstocks.	do.	do.
Paraguay bur........	Acanthospermum officiale.[1]	N. C. to La.	Mar. to Dec.	Seeds; runners; animals.	Cult. and waste land, wool, cotton.	Cultivation; growing dense crops.
Pennycress, French-weed.	Thlaspi arvense.[1]	N. D. to Minn. and Ohio.	June to Dec.	Seeds; wind.	Grainfields; pastures; dairy products.	Burning; thorough cultivation.
Pigeon grass, foxtail, yellow foxtail.	Chaetochloa glauca.[1]	Everywhere.	July to Nov.	Seeds; in clover seed.	Cultivated land; grain crops.	do.

Pigweed, rough amaranth.	Amaranthus retroflexus.[1]	Everywhere.	Aug. to Nov.	Seeds.	Cultivated land; all crops.	Prev. of seeding; thorough cultivation.
Prickly lettuce, compass plant, milkweed, wild lettuce.	Lactuca scariola.[1]	Ohio to Ia. and U. to Or.	July to Nov.	Seeds; wind.	Everywhere; all crops.	Prev. of seeding; burning.
Purslane, garden purslane, pursley, pusley.	Portulaca oleracea.[1]	Everywhere.	June to Dec.	Seeds.	Cultivated land; garden crops.	Closer cultivation.
Ragweed, bitterweed, hogweed, richweed, Roman wormwood.	Ambrosia artemisiæfolia.[1]	do.	Aug. to Nov.	Seeds; wind.	Everywhere; all crops.	Prev. of seeding; mowing stubble.
Ramsted, snapdragon, toad flax.	Linaria linaria.[1]	Me. to Wis. and southward.	Aug. to Dec.	Seeds in grass seed; rootstocks.	Meadows and pastures.	Cultivation; spudding; cropping.
Rib grass, black plantain, buckhorn, ripple grass.	Plantago lanceolata.[3]	Nearly everywhere.	July to Nov.	Seeds; in grass seed.	Everywhere; all crops.	Clean seed; cultivation.
Russian thistle, Russian tumbleweed.	Salsola kali tragus.[1]	Mich. to Colo.	Aug. to Nov.	Seeds; wind.	Everywhere; small grain.	Cultivation; burning.
Shepherd's purse, pickpurse, toothwort.	Bursa bursa-pastoris.[1]	Everywhere.	May to Dec.	Seeds.	Everywhere, all crops.	Cultivation.
Smartweed, knotweed.	Polygonum pennsylvanicum.[1]	Ohio to Neb.	Aug. to Sept.	do.	do.	Prev. of seeding; cultivation.
Sorrel, field sorrel, horse sorrel, sourweed	Rumex acetosella.[3]	Nearly everywhere.	June to Nov.	Seeds, in clover seed; rootstocks.	Meadows; pastures.	Cultiv.; smothering crops; lime and ashes.
Spiny cocklebur, Chinese thistle.	Xanthium spinosum.[1]	Md. to Tex. and Cal.	Aug. to Nov.	Seeds; animals.	Waste land; pastures, wool.	Prev. of seeding; cultivation.
Squirrel tail, foxtail, wild barley.	Hordeum jubatum.[1]	Tex. to Mont.	July to Oct.	Seeds, wind; animals.	Pastures.	do.
Sunflower, common sunflower.	Helianthus annuus.[1]	Neb. to La. and Tex.	Aug. to Oct.	Seeds.	Cultivated land.	Prev. of seeding.
Wild buckwheat, black bindweed.	Polygonum convolvulus.[1]	Mich. to N.D.	July to Oct.	Seeds, in grain seed.	Grain and corn fields.	Sowing clean seed; cultivation.

TABLE OF NOXIOUS WEEDS—(*Continued*).

Common Names.	Technical Name.	Where Injurious.	Time of Seeding.	Methods of Propagation and Distribution of Seed.	Place of Growth and Products Injured.	Methods of Eradication.
Wild carrot, bird's nest, Queen Anne's lace.	Daucus carota.[2]	Me. to Va. and Ind.	July to Nov.	Seeds; animals; wind.	Meadows; pastures.	Grubbing in fall; cultivation.
Wild licorice.........	Glycyrrhiza lepidota.[3]	Minn. to Cal.	Aug. to Nov.	Running rootstocks; seeds; burs carried by animals.	Open prairie; burs injurious in wool.	Subsoiling in dry weather; persistent cultiv.
Wild oats............	Avena fatua.[1]	do.	July to Sept.	Seeds, in seed oats.	Oatfields.	Sowing clean seeds; burning; pasturing.
Wild onion, field garlic, wild garlic.	Allium vineale.[3]	Penn. to S. C.	Aug. to Sept.	Bulblets; seeds.	Everywhere; dairy products; grain.	Alternate cultiv. and heavy cropping.
Yard grass, wire grass, crab grass.	Eleusine indica.[1]	N. J. to Tex.	Aug. to Nov.	Seeds; carried by animals.	Grainfields and vineyards.	Cultiv., with hoed crops.
Yellow daisy, brown-eyed Susan, niggerhead.	Rudbeckia hirta.[2]	Me. to Ohio.	July to Sept.	Seeds.	Meadows; pastures.	Prev. of seeding; cultivation.
Yellow dock, broad-leafed dock.	Rumex obtusifolius.[3]	Me. to Wis.	Aug. to Oct.	do.	do.	do.
Yellow dog fennel....	Helenium tenuifolium.[1]	Tex. to Ga.	Aug. to Nov.	do.	Waste land; pastures.*	do.
Yellow melilot; yellow sweet clover.	Melilotus officinalis.[1]	Md. to Mich.	July to Oct.	Seeds; in hay and clover seeds.	Clay soil; dry meadows and pastures.	Cultiv.; increased fertilization; reseeding meadows.

* Dairy products or milk; it produces very bitter milk when eaten in pastures.

VIII. ENEMIES OF FARM CROPS.

TREATMENTS FOR INJURIOUS INSECTS AND FUNGUS DISEASES OF PLANTS.

By the late Prof. E. S. Goff, of Wisconsin Experiment Station.

The value of the following treatments for preventing injury to crops from insects and fungus diseases has been proved by abundant experience. It is essential that the treatments be given *promptly* and *thoroughly*. In the case of fungus diseases, it is generally essential that the applications be made *before the disease appears*, since they are preventive, rather than curative. *The treatments considered most important are printed in italics.* As a rule, those not so printed need be given only in seasons or localities in which the attack is serious.*

Formulas.

No. 1. *Bordeaux Mixture.*—Place 4 pounds of copper sulfate in a cloth sack and suspend this over night in a wood vessel containing 4 gallons of water, immersing the sack. In another wood vessel slake 6 pounds of fresh lime in as many gallons of water. When the lime is cool, pour it and the copper sulfate solution into a barrel and add enough water to make 45 gallons. Apply at once with a force-pump, with spraying nozzle, stirring frequently during the application.

No. 2. *Ammoniacal Copper Carbonate.*—Dissolve 1 ounce of copper carbonate in 3 pints of strong ammonia and add this solution to 25 gallons of water. Apply as in No. 1. No stirring is required.

No. 3. *Copper Sulfate Solution.*—Dissolve, as directed in No. 1, 1 pound of copper sulfate in 15 gallons of water. Apply as in No 2.

No. 4. Stir 4 ounces of *Paris green* in 40 gallons of water, and add ½ pound of fresh lime, slaked in 2 quarts of hot water. Apply as in No. 1.

No. 5. *Bordeaux Mixture* (No. 1), with *Paris green* added at the rate of 1 ounce to 10 gallons. Apply as in No. 1.

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* The following scheme for treating crops is after a plan published by the late Mr. E. G. Lodemann of Cornell University, in Trans. N. Y. State Agricultural Society for 1893, pp. 176–179.

No. 6. ***London purple***, 4 ounces, very thoroughly mixed with 25 pounds of *land plaster*. Apply with a sprinkling-box.

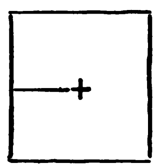
No. 7. Mix 1 ounce of fresh powdered *white hellebore* in 3 gallons of water. Apply at once with force-pump or sprinkling pot.

No. 8. *Kerosene Emulsion.*—Dissolve ¼ pound hard, or 1 quart of soft soap in 2 quarts of boiling water; place 1 pint of kerosene in a tin can; pour the boiling-hot solution into this, cork, and shake rapidly for 1 minute. Before using, dilute with its own bulk of warm soft-water. Apply as in No. 2.

No. 9. Mix 1 pound of fresh *Pyrethrum powder* with an equal bulk of air-slaked lime in a bottle or tin can; cork tightly and leave 24 hours before use. Apply in still air, with sprinkling-box or powder-bellows.

No. 10. *Air-slaked lime* applied with a sprinkling-box.

No. 11. Cut small cards from thin tarred paper, slit one side to the centre, and make a short cross-cut near the end of the slit, as in drawing.



No. 12. *Corrosive Sublimate Solution.*—Dissolve 2¼ ounces of corrosive sublimate in 2 gallons of hot water, and pour this solution into 15 gallons of cold water. Use wood, earthen, or glass vessels. For *potato scab* the formaldehyd treatment is preferable (see p. 107).

No. 13. *Potassium Sulfid Solution.*—Dissolve ½ ounce of potassium sulfid (liver of sulfur, sulfuret of potassium) in 1 quart of warm (not hot) water, and add this solution to 3 quarts of cold water. Apply as in No. 2.

SPRAYING CALENDAR

	First Treatment.	Second Treatment.	Third Treatment	Fourth Treatment.	Fifth Treatment.	Remarks.
Apple.	When buds begin to swell, No. 3, for scab.	When leaf-buds are expanding, No. 8, for aphis.	*Just before flowers open, No. 5, for scab, bud-moth and leaf-roller.*	*When petals have fallen. No. 5. for scab and codling-moth.*	*8 to 12 days later repeat 4th treatment for scab and codling moth.*	Should June prove rainy, use No. 1 the latter part of month. Blight should be watched for, and all affected branches promptly removed and burned.
Bean.	*When third leaf expands, No. 1, for anthracnose.*	*Repeat 1st treatment 10 days later.*	Repeat same 2 weeks after second.	Repeat same 2 weeks after third.		
Cabbage, Cauliflower.	*Keep young plants covered, as they vegetate, with No. 10, for flea-beetle;* sifted road dust or coal ashes will answer.	Use No. 11 at time of setting early plants, for root-maggot. Place closely about stem at surface of ground	If green worms appear before heading, No. 6.	If green worms appear while heading, No. 7.		Should the aphis appear, cultivate thoroughly and apply stimulating manure.
Cherry.	When leaf-buds open, No. 8, for aphis, followed next day with No. 1, for rot.	When fruit has set use No. 1, for rot. Should slug appear on leaves, use No. 10.	10 to 14 days later, No. 1, for rot.	10 to 14 days after 3d treatment, No 2, for rot.		Watch branches at all times for black-knot and cut out as soon as discovered.
Currant.	*At first sign of worms, No. 4.*	10 days later, No. 7.	If worms persist, repeat 2d treatment.			Where leaves are affected with mildew, use No. 1 at time of first treatment.

SPRAYING CALENDAR.—*Continued.*

	First Treatment.	Second Treatment.	Third Treatment.	Fourth Treatment.	Fifth Treatment.	Remarks.
Egg-plant.	*Use No. 6 freely for potato-beetle.*	*Repeat the use of No. 6 as often as seems necessary.*				
Gooseberry	*When leaves expand, No. 1, for mildew.*	*At first signs of worms, No. 5.*	10 *to* 14 *days later, No.* 13. *Should worms persist, No.* 7.			Repeat 3d treatment as often as indications of mildew appear.
Grape.	When leaf-buds are swelling, No. 3, for fungi.	*When leaves are half-grown, No.* 1, *for fungi.*	*When flowers are open, No.* 1, *for fungi.*	10 *to* 14 *days later, repeat 3d treatment.*	If disease appears, repeat same.	*In wet seasons use No.* 2 *August* 1.
Melon. Squash, Cucumber.	*Cover hills at time of planting with light frames covered with mosquito-netting, for striped-beetle.*	Should squash bugs appear, pick off, or trap beneath leaves.	Should squash-vine borer appear, cut out or cover joints of vines with earth.			
Nursery stock.	*When first leaves appear, No.* 1 *for fungous diseases.*	*In* 10 *to* 14 *days repeat 1st treatment.*	In 10 to 14 days more, repeat first treatment.	In 10 to 14 days more, repeat 1st treatment.		
Peach and Nectarine.	*Before buds swell, No.* 3, *diluting to* 25 *gallons, for rot and mildew.*	Before flowers open, No. 1, for rot and mildew.	*When fruit is well advanced, No.* 1, *for same.*	*When fruit is grown, No.* 2, *for same.*		For later varieties the 4th treatment may need to be repeated.
Pear.	As buds are swelling, No. 3, for scab and leaf-blight.	After leaves open, No. 8, for psylla.	*Just before blossoms open, No.* 1, *for scab and leaf-blight.*	*After petals have fallen, No.* 5, *for scab, leaf-blight, and codling-moth.*	After 10 or 12 days repeat 4th treatment. *Remove all branches affected with blight.*	Should June prove wet, use No. 1 once or twice during latter part of the month. *Watch for blight all summer.*

SPRAYING CALENDAR.—*Continued.*

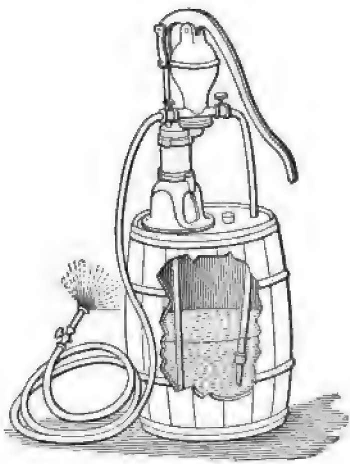
	First Treatment.	Second Treatment.	Third Treatment.	Fourth Treatment.	Fifth Treatment.	Remarks.
Plum.	When buds are swelling, No. 3, for fungous diseases. *Remove all branches affected with black-knot.*	*When petals have fallen, No. 1, for fungous diseases. Continue the watch for black-knot.*	10 *to* 14 *days later, repeat 2d treatment. Look out for black-knot.*	After 10 to 20 days longer repeat 2d treatment.	After 10 to 20 days longer No. 2, for fungous diseases.	*Begin jarring trees for curculio when petals have fallen, and continue until no more are found.*
Potato.	*Soak seed-tubers in No. 12 one and a half hours, for scab.**	*When beetles appear, No. 6.*	*When plants are 6 inches high, No. 5, for beetles and blight.*	10 days later, No. 1, for blight.		*Should weather prove warm and wet, use No. 1 frequently until tops die, for rot.*
Quince.	When blossom-buds appear, No. 1, for leaf and fruit spot.	When fruit has set, repeat 1st treatment.	*After* 10 *to* 20 *days, repeat first treatment.*	*Repeat 1st treatment in* 10 *to* 20 *days longer.*		
Raspberry, Bl'kberry, Dewberry.	Before leaf buds open No. 3, for anthracnose.	When leaves are well-formed, No. 1, for anthracnose.	Watch canes for symptoms of anthracnose and, if found, repeat 2d treatment.			*Remove and burn all plants affected with orange-rust as soon as observed.*
Strawberry.	Should leaf-roller appear, No. 7.	*After fruit is all gathered mow off foliage, and when dry, burn, with the mulching, for rust.*	If season is dry, apply water plentifully, for rust.			
Tomato.	Two weeks after planting out, No. 1, for rot and blight.	10 days after, repeat 1st treatment.	Repeat 1st treatment in 10 to 20 days.			Should weather be warm and wet, repeat 1st treatment often.
Turnip.	Young plants, see Cabbage.					

* See page 107 for description of Formaldehyd method.

A CHEAP ORCHARD-SPRAYING OUTFIT.

(U. S. Dept. of Agriculture.)

Spraying to control various insect pests, particularly those of the orchard and garden, has reached so satisfactory and inexpensive a basis that it is recognized by every progressive farmer as a necessary feature of the year's operations, and in the case of the apple, pear, and plum crops the omission of such treatment means serious loss. The consequent demand for spraying apparatus has been met by all the leading pump manufacturers of this country, and ready-fitted apparatus, consisting of pump, spray tank or barrel, and nozzle with hose, are on the market in numerous styles and at prices ranging from $20 upward. The cost of a spraying outfit for orchard work may, however, be considerably reduced by purchasing merely the pump and fixtures, and mounting them at home on a strong barrel. An apparatus of this sort, representing a style that has proven very satisfactory in practical experience, is illustrated in the accompanying figure. It is merely a strong pump with an air-chamber to give a steady stream, provided with two discharge hose-pipes. One of these enters the barrel and keeps the water agitated and the poison thoroughly intermixed, and the other and longer one is the spraying hose and terminates in the nozzle. The spraying-hose should be about 20 feet long, and may be fastened to a light pole. preferably of bamboo, to assist in



Orchard-spraying Apparatus.

directing the spray. The nozzle should be capable of breaking the water up into a fine mist spray, so as to wet the plant completely with the least possible expenditure of liquid. The two more satisfactory nozzles are those of the Nixon and the Vermorel type. A suitable pump with nozzle and hose may be obtained of any pump manufacturer or hardware dealer at a cost of from $13 to $15. If one with brass fittings be secured it will also serve for the application of fungicides. The outfit outlined above may be mounted on a cart or wagon, the additional elevation secured in this way facilitating the spraying of trees, or for more extended operations, the pump may be mounted on a large water tank.

PREVENTION OF OAT-SMUT. (GOFF.)

The smut of oats, which causes an annual loss to the farmers of the United States amounting in the aggregate to millions of dollars, may be entirely prevented by treating the seed oats before sowing, at a cost for labor and materials which need not exceed five cents per acre of oats sown.

Two methods of treatment have been found satisfactory. These we will call for convenience the *Formaldehyd Treatment* and the *Hot-water Treatment*. The first has the advantage of being the simpler, but it requires a small cash outlay for materials. The second requires no materials or apparatus except what the farmer already has, unless it be a good thermometer.

The Formaldehyd Treatment.—Soak the seed oats one hour in a solution of formaldehyd, made by adding one ounce of formaldehyd to every 3½ gallons of water. Place the water in a barrel, or other convenient vessel, add the formaldehyd to it, and pour in one and one-half bushels of seed oats for each 3½ gallons of the solution. At the end of one hour, draw off or pour off the part of the solution that is not absorbed by the oats, and spread the oats on a clean floor to dry. They should be shoveled over once or twice a day until dry enough to sow.

Formaldehyd is a liquid that may be purchased at drugstores. Ask for *forty-per-cent* formaldehyd. It costs from 50 to 60 cents per pint, and a pint contains enough for about 30 bushels of seed oats. It is sold in smaller quantities at 10 cents per ounce. If formaldehyd is purchased in considerable quantities, it will be well to have the druggist weigh out one ounce in a small bottle, and then mark on the bottle the height to which the ounce reaches. This bottle may then be used as a measure in adding the formaldehyd to the water.

The Hot-water Treatment consists in soaking the seed 10 minutes in water at a temperature of 133° F. Heat the water in a large kettle, and close by sink a barrel in the ground to within a foot of the top. Pour a part of the hot water into the barrel, and take the temperature with a good thermometer. Then add either cold or hot water, stirring it in the mean time, until it shows a temperature of 138°. Put about a bushel of oats in a coarse gunnysack, tie this to one end of a pole and rest the pole over a post, thus making a lever, by which the sack of oats may be easily raised or lowered. Now dip the sack of oats into the water in the barrel. The water will be immediately cooled, and hot water must be added to keep the temperature about 133°. Let one person attend to the temperature, and another to handling the oats. Keep the oats moving in the barrel. Take them out at the end of 10 minutes, dip the sack at once in cold water, then spread on a clean floor to dry. Shovel them over three times a day for a few days, when they may be sown with a force drill; or in two or three hours they may be sown broadcast. As the oats absorb considerable water, it is necessary to sow about half a bushel more per acre than when untreated seed is used. This is on the basis of two and one-half bushels per acre. Two men in one day can treat enough seed to sow twenty acres.

This treatment may also be applied with satisfactory results for the prevention of smut of other cereals than oats, and for prevention of potato-scab, as will be seen from the following article.

THE FORMALDEHYD TREATMENT FOR THE PREVENTION OF THE SMUTS OF CEREAL GRAINS AND OF POTATO-SCAB. (Bolley.)

For Wheat, Oats, Barley, and Millet.—Use formaldehyd (40 per cent solution) at the rate of 1 pound of the liquid to 45 or 50 gallons of water. Use any method of wetting the grain most suited to your means. Sprinkling and shoveling is as effective as dipping, if carefully done.

It is well to treat one day and allow the grain to remain piled up overnight, thus allowing the fumes of the solution to act throughout the pile.

Cautions.—(1) In the case of oats or barley the wetting must be more thorough than in the case of wheat, so that the formaldehyd or gas may penetrate beneath the husks of the grain.

(2) Do not allow wet grain to remain in a pile long enough to get hot. A very slight degree of fermentation may greatly reduce the yield.

For Potato-scab.—Soak the tubers before cutting one hour and a half in a solution of formaldehyd at the rate of one pound of the liquid to thirty gallons of water; or in a solution of corrosive sublimate, using one pound of the chemical to each fifty gallons of water.

Note: The potato-scab fungus lives from year to year in the soil and upon old vines. Hence it is wise to try to keep it off your lands, by treating all seed-tubers. (See Bull. 37, N. D. Experiment Station.)

FIGHTING THE CHINCH-BUG BY MEANS OF KEROSENE EMULSION. (GOFF.)

Experiments have established the fact that with thorough work according to the directions given below the kerosene emulsion will prevent the invasion of cornfields by chinch-bugs, even though the bugs appear in great numbers.

How to Make and Apply the Kerosene Emulsion.—Slice half a pound of common bar soap, put it in a kettle with one gallon of soft water, and boil until dissolved; put two gallons of kerosene in a churn or stone jar, and to it add the boiling-hot soap solution; churn from twenty to thirty minutes, when the whole will appear creamy. If properly made, no oil will separate out when a few drops of the emulsion are placed on a piece of glass. To each gallon of the emulsion add eight gallons of water and stir. Apply with a sprinkling-pot.

Every farmer should learn to make this emulsion, as it is a most useful insecticide. It is especially valuable for killing lice on cattle and hogs. Paris green will not kill chinch-bugs.

The bugs will be very likely to enter cornfields bordering grainfields, after the grain is cut. Before they have had time to do this plough a deep furrow along the side of the field they will enter, and throw into it stalks of green corn. When the bugs have accumulated on the corn, sprinkle with the emulsion. Put in fresh stalks and sprinkle whenever the bugs accumulate. If they break over the barrier, as they probably will, run a few furrows a few rows back in the field, and repeat. When they have attacked stalks of standing corn, destroy by sprinkling.

If the remedy is tried, it should be used persistently. To kill one lot of bugs and then stop will do little or no good. When the bugs threaten to destroy as much as five or ten acres, it will pay for one or two men to devote their whole time to the warfare. Only a part of each day, however, will be needed. Some corn will be lost at best, but the most of the field should be saved.

IX. FORESTRY.

FORESTRY FOR FARMERS.

By Dr. B. E. Fernow, late Director of the New York State College of Forestry.

There has been much talk about forestry in the U. S., but there has been little application of the teachings of that science. This is easily explained in so far as the lumbermen are concerned, who are in the business of making money by cutting the virgin woods, similar to the mining of ore, but it is less intelligible with the farmer who is presumed to be in the business of making money by the production and harvesting of crops, which he grows on the soil of his farm.

That his wood-lot could and should by him be also treated as a crop seems rarely to have entered his mind. Whether he starts out, as in the prairie portions of the State, by planting a grove, or whether he cuts his wood from the virgin growth which he left after clearing enough for field and meadow, in either case he should fully realize that he is dealing with a valuable crop, which requires and will pay for the attention and application of knowledge in its management, such as a true husbandman would give to it.

The Wisconsin farmer, just as his neighbor in Minnesota, living in a State largely covered with timber of great value, has special reason to practise the principles of forestry in order to get the most out of this part of the property both for the present and the future. And those who are located in the prairie portions have no less need of maintaining a forest growth on some part of their farm as a matter of proper management of their resources.

The first thing, as with every other crop, that will have to be decided is on what portions of the farm this wood-crop is best propagated. In deciding about the location of the wood-lot the farmer must keep in mind:

1. That wood will-grow on almost any soil, which is unfit for agricultural use; that, although it grows best on the

best sites, it is to be mainly considered and used as a "stop-gap" to make useful those parts which would otherwise be waste.

2. That a forest growth, besides furnishing useful material, is a condition of soil-cover which affects other conditions, namely, of climate and water-flow, and hence its location should be such as to secure the most favorable influence on these.

3. That the wood-crop does not live on the soil, but on the air, enriching the soil in nutritive elements by its decaying foliage rather than exhausting it, and hence that no manuring and no rotation of crops is necessary as in field crops; in other words, the location of the wood-crop can be made permanent.

A wood growth should therefore be maintained on the farm:

a. Wherever the ground is too wet or too dry, too thin or too rocky or too steep, for comfortable ploughing and for farm crops to do well, or for pasturage to last long, or, in general, where the ground is unfit for field and meadow.

b. On the highest portions of the farm, the tops of hills and also in belts along the hillsides, so as to interrupt continuous slopes, which might give rise to such a rush of surface-waters as to gully the ground and make it unfit for field crops or pasture; the gentler slopes which are liable to washing should at least be kept in grass or terraced for crops to prevent the rush of surface-waters.

c. Along watercourses, where narrower or wider belts of timber should be maintained to prevent undermining of banks and washing of soil into the streams if ploughed too close to the border; the shade of a forest growth would also check rapid evaporation of smaller watercourses.

d. Wherever the protection by a wind-break against cold or hot winds is desirable, for which purpose the timber belt is of more far-reaching effect than the wind-break of a single row of trees; the reduced evaporation from the fields due to this protection has been known to increase the yield of field crops by as much as 25 per cent.

e. On all unsightly places, which impair the general

aspect of the farm—and there are few farms without these—a few trees, a small grove, will add to the thrifty appearance of the farm, make useful the otherwise waste spots, and serve as shelter to grazing cattle, etc.

Altogether, the farmer should realize that husbandry of soil and water is the secret of future success, and that successful water management is best attained by the maintenance of properly located and well-managed forest areas.

There is much extravagant talk about the influence of forests on climate and on rainfall especially. We have but little definite knowledge on these subjects, but it takes no expert, only a little observation, to appreciate the effects of a wind-breaking timber belt on one's own feeling, and it takes but little reasoning to appreciate that the field crop in the shelter of the timber belt participates in this feeling. The dry winds are the great bane of field crops in the West, because they dissipate the moisture; a timber belt breaks their force and reduces thereby their evaporating power.

Just so it takes no great philosopher to see that when rain falls on naked ground it compacts that ground and by and by prevents itself from penetrating; the water is forced to drain off superficially and rapidly, instead of sinking into the ground and remaining there for the use of field crops. And that the washing and gullying of the soil is also a result of this rushing off of surface-waters, due to the clearing away of its plant-cover, requires no wise man to point out; every farmer experiences it more or less every year.

That any one farmer's neglect or the devastation of any small part of the forest growth should have an influence on the rainfall or climate of the whole country nobody should claim; but the conditions surrounding each particular farm, its local climate, soil, and water conditions, are changed, and finally the aggregate changes make themselves felt over the whole state.

Now as to the management of the wood-lot a few hints may be acceptable. The farmer may not necessarily employ the finer methods of managing the wood-crop, but by the mere application of common sense and a little knowledge of tree-life he may do better than he does at present.

He should at least observe the following rules:

1. Fire should be carefully kept out of the wood-lot, for it has in no way a beneficial effect. It kills not only the undergrowth, which is desirable because it helps to shade the soil, and injures, if it does not kill, the young tree growth, which is to take the place of the older growth, but the worst effect is that it consumes the vegetable mould which has accumulated by the fall and decay of leaves, twigs, and other vegetation, and which forms the manure, the fertility, of the soil. Fire is to be used only when through bad management or otherwise a dense undesirable undergrowth has come in, which it is too expensive to remove in other ways when the time for natural reproduction has come or planting is to be done. It must then be used with caution in early spring or late fall, before the brush is too dry, when the fire will smoulder rather than burn fiercely and can be kept within bounds.

2. Cattle must be kept out where young forest growth is to be fostered. Sheep and goats especially are of no benefit to wood-crops, but horses and cattle may be allowed to browse through the wood-lot where the young growth has passed out of their reach. Pigs are a benefit by working over the ground and thereby burying seeds, especially acorns; but after the seed is so brought under ground where a young crop is expected to be reared next year they must be kept out. Altogether, the cattle and farm animals should be kept where you want them, and not where you do not want them. Sometimes, however, the roaming of cattle may be beneficial by keeping down too dense impenetrable underbrush in young sapling growth.

It is better to so cut and manage the old timber that a desirable new growth will spring up than to cut clean and replant. Planting should be done only where there is no desirable natural tree growth. Hence where there is a well-established wood-lot, the whole management of the crop consists in proper cutting.

How this is best done cannot be described readily within the short space of this article, but every farmer who is interested in learning the principles of using the axe to

advantage in reproducing a wood crop or how to establish a wood-lot can obtain from the U. S. Department of Agriculture, free of charge, a pamphlet entitled "Forestry for Farmers," in which in plain language is discussed in detail how trees and forests grow, how to start a wood-crop, and how to manage the wood-lot.

It does not exhaust the subject, but merely teaches the first steps, and the thinking farmer will find his way of stepping farther.

NUMBER OF TREES ON AN ACRE. (EGLESTON.)

The number of trees needed to plant an acre of ground, at various distances apart, is as follows:

2 ft. apart each way	10,890	12 ft. apart each way...	302
3 " by 2 ft.........	7,260	15 " " " "...	200
3 " apart each way	4,840	18 " " " "...	135
4 " " " "	2,722	20 " " " "...	110
5 " " " "	1,742	22 " " " "...	90
6 " " " "	1,210	25 " " " "...	70
8 " " " "	680	30 " " " "...	50
10 " " " "	435		

Rows six feet apart, and trees one foot apart in the row, 7260 trees per acre.

Rows eight feet apart, and one foot apart in the row, 5445 trees per acre.

Rows ten feet apart, and one foot apart in the row, 4356 trees per acre.

One mile of wind-breaks or shelter-belt requires 5280 trees, or cuttings for a single row one foot apart in the row.

FUEL VALUE AND SPECIFIC GRAVITY OF SOME OF THE MORE IMPORTANT WOODS OF THE UNITED STATES. (Sargent.)

Note.—The term *Atlantic* indicates the region east of the eastern base of the Rocky Mountains; the term *Pacific*, the region west of that line.

No.	Common Name.	Botanical Name.	Region.	Fuel Value.		Order by Weight.	Specific Gravity.	Weight per Cubic Foot, lbs.
				Per Cubic Decimeter.	Per Kilogram.			
1	Mountain Mahogany	Cercocarpus ledifolius	Interior Pacific	4,234.06	4,052.90	34	1.0447	65.10
2	Southern or Long-leaved Pine	Pinus australis	South Atlantic Coast.	4,113.33	5,545.82	1	0.7417	46.22
3	Shellbark or Shagbark Hickory	Carya alba	Atlantic	3,851.17	4,078.76	28	0 9442	58.84
4	Chestnut Oak	Quercus Prinus	"	3,843.69	3.997.32	38	0.7114	44.32
5	Pitch Pine	Pinus rigida	Atlantic Coast	3.472.26	5,491 47	2	0.6323	39.40
6	Pignut Hickory	Carya porcina	Atlantic	3,392.12	3.922.89	43	0.8647	53.88
7	White Hickory	Carya tomentosa	"	3,380 57	3,904.11	45	0.8659	53.96
8	Pitch-pine	Pinus Cubensis	South Atlantic Coast.	3,363.40	4.418.55	8	0.7612	47.44
9	Mesquite	Prosopis juliflora	Texas to California	3.291.21	4.352.30	11	0.7562	47.12
10	Overcup Oak	Quercus lyrata	Southern Atlantic	3.268.92	4,102.65	25	0.7962	49.61
11	White Elm	Ulmus Americana	Atlantic	3,247.02	4,191.87	19	0.7746	48.27
12	White Oak	Quercus alba	"	3,197.41	4.187.83	21	0.7635	46.58
13	Spanish Oak	Quercus falcata	Southern Atlantic.	3,193.28	4,055.48	33	0.7874	49.07
14	Cedar	Juniperus occidentalis, var. monosperma	Pacific	3,143.57	4,587.81	6	0.6852	42.70
15	Bitter Pecan	Carya aquatica	Southern Atlantic	3,140.33	4,073.59	30	0.7709	48.04
16	Yellow Pine	Pinus mitis	" "	3,091.82	5,062.75	3	0.6107	38.06
17	Sugar Maple	Acer saccharinum	Atlantic	3,091.37	4,345.48	12	0.7114	44.32
18	Red Oak	Quercus rubra	"	3,062.08	4,075.16	29	0.7514	46.72
19	Persimmon	Diospyros Virginiana	"	2,970.45	3,781.61	50	0.7855	48.95
20	Larch or Tamarack	Larix Americana	Northern Atlantic.	2,937.46	4,182.04	22	0.7024	43 77

21	Butternut Hickory	Carya amara	Atlantic	2,863.42	3,903.25	46	0.7336	45.71
22	Locust	Robinia Pseudacacia	Allegheny Mountains	2,822.99	3,890.02	48	0.7257	45.22
23	Beech	Fagus ferruginea	Atlantic	2,795.34	3,895.04	47	0.7175	44.71
24	Pecan	Carya olivæformis	Southern Atlantic	2,768.72	3,954.75	41	0.7001	43.63
25	Black-jack	Quercus nigra	" "	2,692.51	3,713.81	54	0.7250	45.18
26	Water-Oak	Quercus aquatica	" "	2,655.82	3,718.07	53	0.7143	44.51
27	White Ash	Fraxinus Americana	Atlantic	2,652.34	4,217.42	17	0.6289	39.19
28	Black Oak	Quercus tinctoria	"	2,595.04	3,774.60	51	0.6875	43.84
29	White Oak	Quercus Garryana	North Pacific Coast	2,594.31	3,667.39	55	0.7074	44.08
30	Canoe Birch	Betula papyracea	Northern Atlantic	2,582.66	4,101.41	26	0.6297	39.24
31	White or Gray Birch	Betula alba, v. populifolia	North Atlantic Coast	2,509.00	4,073.05	31	0.6160	38.05
32	Yellow Pine	Pinus ponderosa	Pacific	2,441.24	4,600.04	5	0.5307	33.07
33	Sycamore	Platanus occidentalis	Atlantic	2,406.89	4,071.83	32	0.5911	36.83
34	Nut-pine	Pinus monophylla	Interior Pacific	2,270.77	4,149.04	23	0.5473	34.11
35	Sweet or Red Gum	Liquidambar Styraciflua	Atlantic	2,255.24	4,016.46	37	0.5615	34.99
36	Scrub or Gray Pine	Pinus Banksiana	Northern Atlantic	2,152.66	4,393.18	9	0.4900	30.54
37	Black Pine	Pinus pungens	Allegheny Mountains	2,054.78	3,995.30	39	0.5143	32.05
38	Red or Norway Pine	Pinus resinosa	Northern Atlantic	2,051.75	4,226.05	16	0.4855	30.26
39	Old Field or Loblolly Pine	Pinus Tæda	Southern Atlantic	2,031.75	4,087.20	27	0.4971	30.98
40	Jersey or Scrub Pine	Pinus inops	Atlantic	2,008.20	4,126.15	24	0.4867	30.33
41	Redwood	Sequoia sempervirens	California Coast	1,985.50	4,191.47	20	0.4737	29.52
42	Black Walnut	Juglans nigra	Atlantic	1,984.56	3,857.26	49	0.5145	32.06
43	Cypress	Taxodium distichum	So. Atlantic	1,921.63	4,705.27	4	0.4084	24.45
44	Cottonwood	Popolus monilifera	Atlantic	1,906.42	4,242.15	15	0.4494	28.00
45	Chestnut	Castanea vulgaris, var. Americana	Atlantic	1,868.25	4,042.96	35	0.4621	28.80
46	Digger or Bull Pine	Pinus sabiniana	California	1,804.29	3,982.97	40	0.4530	28.28
47	Tamarack	Pinus contorta, var. Murrayana	Pacific	1,791.33	4,019.13	36	0.4457	27.78
48	Sugar-pine	Pinus Lambertiana	California	1,785.40	4,419.31	7	0.4040	25.18
49	Red or Yellow Fir	Pseudotsuga Douglasii	Pacific	1,766.32	4,354.84	10	0.4056	25.28
50	Hemlock	Tsuga Canadensis	Northern Atlantic	1,724.26	4,208.58	18	0.4097	25.53
51	Aspen	Populus tremuloides	Atlantic and Pacific	1,624.64	4,292.31	13	0.3785	23.59
52	Black Spruce	Picea nigra	Northern Atlantic	1,614.11	3,949.37	42	0.4087	25.47
53	White Pine	Pinus strobus	" "	1,489.03	4,272.69	14	0.3485	21.72
54	Yel. Poplar or Tulip Tree	Liriodendron tulipifera	Atlantic	1,425.57	3,744.61	52	0.3807	23.72
55	Yellow or White Cedar	Thuga occidentalis	Northern Atlantic	1,411.57	3,917.77	44	0.3603	22.45

DISTANCE TABLE FOR TREE-PLANTING. (Yearbook U. S. Dept. of Agriculture.)

Number of Trees that may be Set upon a Piece of Land 100 Yards or Feet Square on a Side in Right-angled Rows at Equal or Unequal Distances Apart.

Yards or Feet between Trees in the Rows.	Yards or Feet between Rows.														
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	7.0	8.0	9.0	10.0
.5	20,000	13,333	10,000	8,000	6,667	5,714	5,000	4,444	4,000	3.636	3.333	2,857	2,500	2,222	2,000
1.0	10,000	6,667	5,000	4,000	3.333	2,857	2,500	2,222	2,000	1,818	1,666	1,428	1,250	1,111	1,000
1.5	6,667	4,444	3,333	2,667	2,222	1,905	1,667	1,481	1,333	1,212	1,111	952	833	740	666
2.0	5,000	3,333	2,500	2.000	1,667	1,429	1,250	1,111	1,000	909	833	714	625	555	500
2.5	4,000	2,667	2,000	1,600	1,333	1,143	1,000	889	800	727	666	571	500	444	400
3.0	3,333	2,222	1,667	1,333	1,111	952	833	741	667	606	555	476	416	370	333
3.5	2,857	1,905	1,429	1,143	952	816	714	635	571	519	476	408	357	317	285
4.0	2,500	1,667	1,250	1,000	833	714	625	556	500	455	416	357	312	277	250
4.5	2,222	1,481	1,111	889	741	635	556	494	444	404	370	317	277	246	222
5.0	2,000	1,333	1,000	800	667	571	500	444	400	364	333	285	250	222	200
5.5	1,818	1,212	909	727	606	519	455	404	364	333	303	259	227	202	181
6.0	1,667	1,111	833	667	556	476	417	370	333	303	277	238	208	185	166
6.5	1,538	1,026	769	615	513	440	385	342	308	280	256	219	192	170	153
7.0	1,429	952	714	571	476	408	357	317	286	260	238	204	178	158	142
7.5	1,333	889	667	533	444	381	333	296	267	242	222	190	166	148	133
8.0	1,250	833	625	500	417	357	313	278	250	227	208	178	156	138	125
8.5	1,176	784	588	471	392	336	294	261	235	219	196	168	147	130	117
9.0	1,111	741	556	494	370	317	278	247	222	202	185	158	138	123	111
10.0	1,000	667	500	400	333	286	250	222	200	182	166	142	125	111	100

In order to find number of trees needed per acre, divide the above figures by 2 if they have been read as referring to feet; multiply them by 4½ if they have been read as referring to yards. This will give the number within an unappreciable error.

STATES AND TERRITORIES OBSERVING ARBOR DAY, WITH DATES. (U. S. Department of Agriculture.)

States.	Year of First Observance.	Time of Observance.
Alabama	1887	22d of February.
Arizona	1890–91	First Friday after 1st of February.
Arkansas		
California	1886	
Colorado	1885	Third Friday in April.
Connecticut	1887	In spring, at appointment of governor.
Florida	1886	January 8.
Georgia	1887	First Friday in December.
Idaho	1886	Last Monday in April.
Illinois	1888	Date fixed by governor and superintendent of public instruction.
Indiana	1884	Date fixed by superintendent of public instruction.
Iowa	1887	Do.
Kansas	1875	Option of governor, usually in April.
Kentucky	1886	Do.
Louisiana	1888–89	Option of parish boards.
Maine	1887	Option of governor.
Maryland	1889	Option of governor, in April.
Massachusetts	1886	Last Saturday in April.
Michigan	1885	Option of governor.
Minnesota	1876	Do.
Mississippi	18[illegible]2	Option of board of education.
Missouri	1886	First Friday after first Tuesday in April.
Montana	1887	Third Tuesday of April.
Nebraska	1872	22d of April
Nevada	1887	Option of governor.
New Hampshire	1886	Do.
New Jersey	1884	Option of governor, in April.
New Mexico	1890	Second Friday in March.
New York	1889	First Friday after May 1.
North Carolina	1893	
North Dakota	1884	6th of May, by proclamation of governor.
Ohio	1882	In April, by proclamation of governor.
Oklahoma	. . .	
Oregon	1889	Second Friday in April.
Pennsylvania	1887	Option of governor.
Rhode Island	1887	Do.
South Carolina	Uncertain	Variable.
South Dakota	1884	Option of governor.
Tennessee	1875	November, at designation of county superintendents.
Texas	1890	22d of February.
Vermont	1885	Option of governor.
Virginia	1892	
West Virginia	1883	Fall and spring, at designation of superintendent of schools.
Wisconsin	1889	Option of governor.
Wyoming	1888	Do.
Washington	1892	Do.

FOREST-FIRE LAWS IN THE UNITED STATES.

(FERNOW.)

(See p. 142 for penalties imposed.)

State.	Edition of Code.	Title.	Chapter.	Section.
Alabama	C. C. 1886			4226-8
Arkansas[1]	S. & H.'s D. 1894		48	1580-4
California[2]	P. C. 1886	10		384
Colorado	Mills, G. S. 1891		36	1414 15, 17-18
Connecticut[3]	G. S. 1888	19	99	1458, 1460-2
Delaware[4]	Vol. XVIII		93	1-2
Florida	Laws 1879			3141
Georgia[5]	1882		10	1456-9
Idaho	R. S. 1887	9		6921
Illinois	R. S. 1895		38	18
Indiana	R. S. 1894		5	2001
Iowa	McLean's, 1888	24	3	5185-92
Kansas	C. L. 1889			7276-8
Kentucky	G. S. 1888		29	5-6
Louisiana	1884			817
Maine	Laws 1891		100	5
Maryland.[6]				
Massachusetts[7]	Sup. 1888		163	1-2
Michigan[8]	Howell's A. S. 1882		328	9402-4
Minnesota[9]	G. S. 1878		95	6
Mississippi	1892		29	1091
Missouri	R. S. 1889		47	3613

[1] S. 1847: Burning off permitted when consent of neighbors is secured after 1 day's notice.

[2] Pol. Code, S. 3344-5: Persons firing woods, etc., liable in treble damages. Constable, etc., may order any inhabitants liable to poll-tax to assist in extinguishing fire.

[3] Must give notice, before burning off, to all residents within one mile, and can only be done between February 15 and March 31, unless otherwise ordered by county commissioner.

[4] Prohibits building fire in woods without owner's permission, and with out first clearing away combustibles, and extinguishing fire.

[5] Must give 1 day's notice, before burning off, to adjoining property owners, and then only betwen Feb. 20 and April 1.

[6] No law included in Revised Statutes.

[7] Ch. 296, S. 1-6, G. S. 1883: Duty of fire wardens to post warnings, extinguish fires, and investigate causes of fires.

[8] Supervisors and highway commissioners to order assistance in putting out fires; fine $5-$50 for refusal to assist.

[9] See act of April 18, 1895.

FOREST-FIRE LAWS—*Continued.*

State.	Edition of Code.	Title.	Chapter.	Section.
Montana[10]	P. C. 1895.			1071–2
Nebraska.	1895		c c. 9–62	6713
Nevada	G. S. 1885.			4794
New Hampshire	P. S. 1891		277	3–7
New Jersey[11]	R. S. 1877.	Fire.		1 and supplements.
New York	R. S	14	20	....
North Carolina[12]	Vol. I. 1883		7	52–4
North Dakota.	1895		P. C. 40	7314–15
Ohio[13]	R. S. 1894			6334
Oregon[14]	Sess. 1893			Page 45
Pennsylvania.	1894.			Act of June 11, 1879–81
Rhode Island	G. S. 1886.		279	6
South Carolina[15]	1893	Crim. Stat.	101	151–7
South Dakota.	Dak. Ter			2398
Tennessee[16]	M. & V. C. 1884			2277–8
Texas	P. C. 1889	17	2	669–70
Utah[17]	C. L. 1888.	10		4576
Vermont.	1894	32	213	4934
Virginia	1887		181	3701–2
West Virginia	1891		2	81–84
Wisconsin	R. S. 1889.			4406
Wyoming[18]	R. S. 1887			920–2
Arizona	R. S. 1887.			608–9
New Mexico	1884			2383–14
Oklahoma[19]	1893		25 / 37 entire.	2269–70

[10] Penalty for failing to extinguish camp-fire or malicious firing of woods, fine not exceeding $5000, or imprisonment not exceeding 5 years, or both.

[11] Ch. 188, G. P. Laws 1888, provides detectives for violators of fire law. Ch. 119, Laws 1892, and Ch. 194, Laws 1894, provide for fire marshals and define their duties.

[12] Fine $10 for leaving unextinguished camp-fire. Two days' notice in writing before firing one's own woods.

[13] S. 4750–1: Penalty for refusing to assist in extinguishing fires, fine $10.

[14] Requires governor to issue proclamation annually July 1, warning people against forest fires.

[15] If turpentine farm, fine $500, or penitentiary 1 year.

[16] Owner may fire his own woods after two days' notice to neighbors.

[17] Ch. 27. Laws 1892: Duty of county sheriffs to extinguish fires.

[18] Permits firing grass and sage-bush March, April, and October, if kept within control.

[19] Camp-fires, and regulations for burning off prairies, etc., Ch. 37 (enacted 1890) provides penalties for setting fires and failure to extinguish.

FOREST-FIRE LAWS—*Continued.*

PENALTY PRESCRIBED BY STATE LAWS.

Alabama.—Fine $10–$200; if turpentine forest, $100–$1000, or hard labor for not more than 12 months.

Arkansas.—Fine $25–$300, or jail 10–60 days. Liable for double damages.

California.—Fine not more than $1000, or jail not more than 1 year, or both.

Colorado.—Fine $50–$300, or jail 15 days to 3 months, or both. If on State lands, $50–$500, or jail 20 days to 6 months.

Connecticut.—Fine $20–$200, or jail 2–6 months, or both. Fine $1–$50, or jail not more than 30 days.

Delaware.—Fine $25.

Florida.—Fine not more than $100, or jail not more than 60 days.

Georgia.—Fine not more than $1000, or 1 year in chain-gang, or both.

Idaho.—Misdemeanor.

Illinois.—Fine $5–$100.

Indiana.—Fine $5–$100, to which may be added imprisonment not more than 30 days.

Iowa.—Fine not exceeding $500, or jail not exceeding 1 year.

Kansas.—Fine $50–$500, or jail 10 days to 6 months, or both.

Kentucky.—Fine $100, or in discretion of jury.

Louisiana.—Fine $5–$500.

Maine.—Fine not exceeding $100, or jail not exceeding 30 days, or both.

Massachusetts.—Fine not more than $100, or jail not more than 6 months.

Michigan.—Fine not more than $100, or jail not more than 1 year, or both.

Minnesota.—State prison 6 months to 2 years.

Mississippi.—Fine $20–$500, or jail not more than 3 months, or both.

Missouri.—Fine not more than $500, or jail not more than 12 months.

Montana.—Fine not more than $1000, or jail not more than 1 year.

Nebraska.—Fine $5–$100, and jail 1–6 months.

Nevada.—Fine $200–$1000, or jail 10 days to 6 months, or both.

New Hampshire.—Fine $10–$2000, or imprisonment not more than 3 years.

New Jersey.—Fine not more than $100, or jail not more than 1 year, or both.

New York.—Fine not exceeding $1000, or imprisonment not exceeding 1 year.

North Carolina.—Fine $50.

North Dakota.—Wilful, a misdemeanor; negligent, fine $10–$100.

Ohio.—Fine not more than $100, or jail not more than 20 days, or both.

Oregon.—Fine $10–$1000, and in certain cases penitentiary not exceeding 1 year.

Pennsylvania.—Fine not more than $300, or jail not more than 1 year, or both.

Rhode Island.—Imprisonment not exceeding 2 years.

South Carolina.—Fine \$5-\$100, or jail not more than 30 days.

South Dakota.—Fine not more than \$200, or jail not more than 1 year, or both.

Tennessee.—Forfeit \$100 to prosecutor and fine \$5-\$50 (S. 2277, Code Sup. 1893).

Texas.—Fine \$50-300.

Utah.—Misdemeanor.

Vermont.—Fine not more than \$500, or penitentiary not more than 5 years.

Virginia.—Fine \$5-\$100, and jail 1-6 months.

West Virginia.—Fine \$10-\$1000, or jail not more than 12 months.

Wisconsin.—Fine not more than \$500, or jail not more than 1 year.

Wyoming.—Fine not more than \$500, or jail 30 days to 6 months.

Arizona.—Misdemeanor. If on State or U. S. lands, fine not more than \$1000, or jail not more than 1 year, or both.

New Mexico.—Fine \$60-\$500.

Oklahoma.--Fine \$10-\$500, or jail not more than 1 year, or both.

X. MANURES AND FERTILIZERS.

It is a matter of common experience among farmers that the soil is impoverished by continuous cropping, and the yields obtained therefore gradually decreased. The decrease in yields can only be prevented by applications of farmyard manure or commercial fertilizers; ploughing and thorough cultivation of the soil bring the land in a better mechanical condition and increase the amount of available plant food present in the soil, but these operations are not sufficient to maintain the fertility of the land so that it will yield equally well from year to year under otherwise favorable conditions. Every crop harvested contains certain quantities of fertilizing ingredients, and taking away these amounts in general leaves the soil in a poorer condition for the production of crops than it was before.

The fertilizing ingredients of which the soil is thus liable to be robbed are potash, phosphoric acid, nitrogen, and sometimes lime. They are not present as such in the soil, or in the fertilizers applied to the soil, but in chemical combinations with a large variety of compounds. The soil will contain nearly all the different elements which chemists have so far succeeded in isolating, but it is mainly the three elements, potassium, phosphorus, and nitrogen, which are apt to be decreased in the soil below the amounts required for the nutrition of crops, or at least of maximum crops. In rational fertilization the effort therefore always is to return to the soil such quantities of fertilizing ingredients, in the shape of farmyard manure or commercial fertilizers, as will restore the loss sustained by the withdrawal of the crops harvested. Other mineral ingredients contained in the crops need not generally be returned to the soil, since they are nearly everywhere present in abundance.

It is the grand work done for the farmer by agricultural chemistry during the past half century which has explained the causes of the decreased fertility of land due to continuous cropping, and has given the remedies for maintaining the fertility. The latter are as follows:

First, by selling only such products from the farm as will deprive the soil of the smallest quantities of fertilizing ingredients, i.e., manufactured products, like milk, cream, butter, meat, eggs, rather than grain crops, hay, etc. The tables given on pp. 148–151 show the amounts of fertilizing ingredients removed in farm products of various kinds and deserve a close study by all farmers.

Secondly, by carefully saving the manure produced by stock—both liquid and solid (the former by the use of absorbents, peat, land plaster, kainit, superphosphate, shavings, etc., or by building special cisterns for storing it; the latter by placing it under shelter, guarding against leakage) —and returning it to the land; as the products sold off the land also contain certain quantities of fertilizing constituents, the loss must be repaired by purchase of concentrated food stuffs, at least three fourths of whose valuable ash ingredients will go into the manure and thus be saved for crops.

Thirdly, by following a rational system of rotation of crops, and by frequent culture of leguminous crops,—clovers, peas, beans, etc.,—since these are able to so fix the free nitrogen of the air as to render it of value to animals and plants.

APPROXIMATE LOSSES OF FERTILIZING MATERIALS IN DIFFERENT SYSTEMS OF FARMING.

(SNYDER.)

System of Farming.	Nitrogen.	Phosphoric Acid.	Potash.
	lbs.	lbs.	lbs.
All grain-farming....................	5600	2500	4200
Mixed grain- and general farming...	2600	1000	1000
Mixed potato- and general farming..	2300	1000	2400
Stock-farming.......................	900	50*	60
Dairy-farming.......................	800	75*	85

* Gain.

The figures given show the approximate losses on a 160-acre farm under the different systems of farming. With stock- and dairy-farming, as well as partly in mixed grain- and general farming, the loss of nitrogen may be avoided by growing clover. In stock and dairy-farming, therefore, no loss of fertility will occur under these conditions when all the skim-milk is fed on the farm and a part of the grain is exchanged for more concentrated milled products, but there will on the contrary be a constant gain of fertility to the soil. (See Bull. 41, Minn. Exp. Station.)

AVERAGE CHEMICAL COMPOSITION OF AMERICAN SOILS.

(King.)

	Insoluble Residue.	Water and Organic Matter.	Potash.	Soda.	Lime.	Magnesia.	Phosphoric Acid.
	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
Sandy soils...	93.21	2.61	.121	.051	.085	.048	.087
Clayey soils	68.21	6.53	.319	.128	.617	.456	.141
Humus soils	35.89	13.94	.639	.109	3.786	.886	.150
Loess soils....	68.85	1.21	.435	.165	5.820	3.692	.200
Humid soils...	84.03	3.64	.216	.091	.108	.225	.113
Arid soils.....	70.57	4.95	.729	.264	1.362	1.411	.117

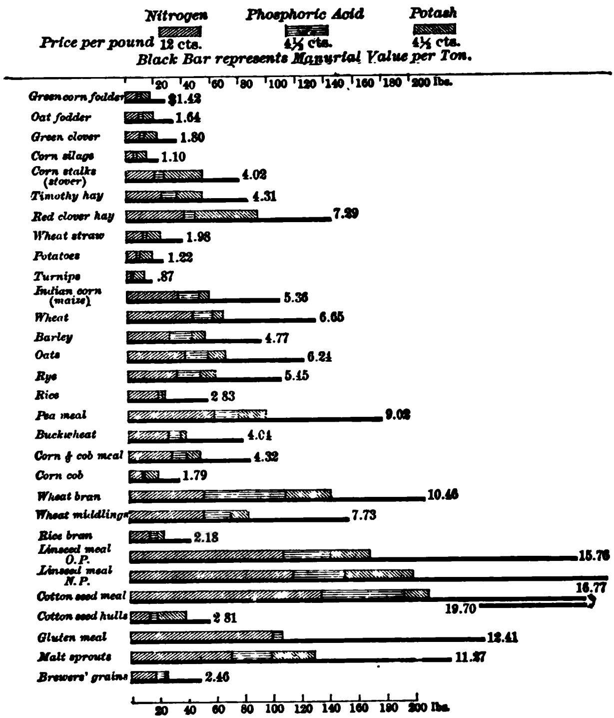
Fertile soils contain the following percentages of different components, according to Snyder (averages for 200 samples):

	Per cent		Per cent
Insoluble matter..........	79.95	Alumina................	5.20
Potash..................	.29	Phosphoric acid.........	.24
Soda....................	.25	Sulphur trioxide.........	.03
Lime....................	2.16	Carbon dioxide..........	1.12
Magnesia................	.55	Volatile matter..........	7.00
Iron oxide...............	2.68		99.47

Volatile matter contained: Humus, 3.35 per cent; Nitrogen, 0.29 per cent.

MANURIAL VALUE OF FEEDING STUFFS.

Chart showing Pounds of Fertilizing Constituents of Feeding Stuffs in one Ton, and the Manurial Value of Feeding Stuffs, according to the Valuation given.



FERTILIZING CONSTITUENTS OF FEEDING STUFFS AND FARM PRODUCTS.

(Yearbook U. S. Dept. of Agriculture.)

Material.	Water.	Ash.	Nitrogen.	Phosphoric Acid.	Potash.
Green Fodders.	per ct.	per ct.	per ct.	per ct.	per ct.
Pasture grass	63.1	3.27	.91	.23	.75
Green fodder corn	78.6	4.84	.41	.15	.33
Sorghum fodder	82.2	......	.23	.09	.23
Rye fodder	62.1	....	.33	.15	.73
Oat fodder	83.4	1.31	.49	.13	.38
Timothy grass	66.9	2.15	.48	.26	.76
Red clover	80.0	....	.53	.13	.46
White clover	81.0	....	.50	.20	.24
Alsike clover	81.8	1.47	.44	.11	.20
Scarlet clover	82.5	....	.43	.13	.49
Alfalfa (lucern)	75.3	2.25	.72	.13	.56
Cowpea	78.8	1.47	.27	.10	.31
Soja bean	73.2	....	.29	.15	.53
Prickly comfrey	84.4	2.45	.42	.11	.75
Corn silage	78.0	....	.28	.11	.37
Hay and Dry Coarse Fodders.					
Fodder corn (with ears)	7.85	4.91	1.76	.54	.89
Corn stover (without ears)	9.12	3.74	1.04	.29	1.40
Hungarian grass	7.69	6.18	1.20	.35	1.30
Common millet	9.75	......	1.28	.49	1.69
Hay of mixed grasses	11.99	6.34	1.41	.27	1.55
Red-top	7.71	4.59	1.15	.36	1.02
Timothy	7.52	4.93	1.26	.53	.90
Red clover	11.33	6.93	2.07	.38	2.20
Mammoth red clover	11.41	8.72	2.23	.55	1.22
White clover	....	....	2.75	.52	1.81
Scarlet clover	18.30	7.70	2.05	.40	1.31
Alsike clover	9.94	11.11	2.34	.67	2.23
Alfalfa	6.55	7.07	2.19	.51	1.68
Barley straw	11.44	5.30	1.31	.30	2.09
" chaff	13.08	....	1.01	.27	.99
Wheat straw	12.56	3.81	.59	.12	.51
" chaff	8.05	7.18	.79	.70	.42
Rye straw	7.61	3.25	.46	.28	.79
Oat "	9.09	4.76	.62	.20	1.24
Buckwheat hulls	11.90	....	.49	.07	.52
Roots, Bulbs, Tubers, etc.					
Potatoes	79.24	.89	.32	.12	.46
Sweet potatoes	71.26	1.00	.24	.08	.37
Red beets	87.73	1.13	.24	.09	.44
Yellow fodder beets	90.60	.95	.19	.09	.46
Sugar beets	86.95	1.04	.22	.10	.48
Mangel-wurzels	87.29	1.22	.19	.09	.38
Turnips	89.49	1.01	.18	.10	.39
Rutabagas	89.13	1.06	.19	.12	.49
Carrots	89.79	1.22	.15	.09	.51

FERTILIZING CONSTITUENTS OF FEEDING STUFFS AND FARM PRODUCTS.—(*Continued.*)

Material.	Water.	Ash.	Nitrogen.	Phosphoric Acid.	Potash.
Grains and Other Seeds.	per ct.	per ct.	per ct.	per ct.	per ct.
Corn	10.88	1.53	1.82	.70	.40
Sorghum seed	14.00	...	1.48	.81	.42
Barley	14.30	2.48	1.51	.79	.48
Oats	18.17	2.98	2.06	.82	.62
Wheat, spring	14.35	1.57	2.36	.70	.39
" winter	14.75	....	2.36	.89	.61
Rye	14.90	....	1.76	.82	.54
Millet, common	12.68	.. ...	2.04	.85	.36
Japanese millet	13.68	....	1.73	.69	.38
Rice	12.60	.82	1.08	.18	.09
Buckwheat	14.10	....	1.44	.44	.21
Soja beans	18.33	4.99	5.30	1.87	1.99
Other Concentrated Feeds.					
Corn meal	12.95	1.41	1.58	.63	.40
Corn and cob meal	8.96	....	1.41	.57	.47
Ground oats	11.17	3.37	1.86	.77	.59
" barley	13.43	2.06	1.55	.66	.34
Wheat flour	9.83	1.22	2.21	.57	.54
Pea meal	8.85	2.68	3.08	.82	.99
Corn cobs	12.09	.82	.50	.06	.60
Hominy feed	8.93	2.21	1.63	.98	.49
Gluten meal	8.59	.73	5.03	.33	.05
Starch feed (glucose refuse)	8.10	....	2.62	.29	.15
Malt sprouts	18.38	12.48	3.55	1.43	1.63
Brewers' grains, dry	9.14	3.92	3.62	1.03	.09
" " wet	75.01	....	.89	.31	.05
Rye bran	12.50	4.60	2.32	2.28	1.40
" middlings	12.54	3.52	1.84	1.26	.81
Wheat bran	11.74	6.25	2.67	2.89	1.61
" middlings	9.18	2.30	2.63	.95	.63
Rice bran	10.20	12.94	.71	.29	.24
" polish	10.30	9.00	1.97	2.67	.71
Buckwheat middlings	14.70	1.40	1.38	.68	.34
Cotton-seed meal	7.81	6.95	6.79	2.88	.87
" hulls	10.17	2.40	.69	.25	1.02
Linseed meal (old process)	8.88	6.08	5.43	1.66	1.37
" " (new process)	7.77	5.37	5.78	1.83	1.39
Apples, fruit	85.30	.39	.13	.01	.19
Apple pomace	80.50	.27	.23	.02	.13
Dairy Products, etc.					
Whole milk	87.00	.75	.53	.19	.18
Skim milk	90.25	.80	.56	.20	.19
Cream	74.05	.50	.40	.15	.13
Buttermilk	90.50	.70	.48	.17	.16
Whey	92.97	.60	.15	.14	.18
Butter	79.10	.15	.12	.04	.04
Cheese	33.25	2.10	3.93	.60	.12
Live cattle	50.2	4.40	2.48	1.76	.16
Sheep	44.8	2.90	1.95	1.13	.14
Swine	42.0	1.80	1.76	.73	.10

AMOUNT OF SOIL INGREDIENTS WITHDRAWN BY VARIOUS CROPS, IN LBS. PER ACRE.

(HILGARD.)

Crops.	Total Ash.	Potash.	Lime.	Phosphoric Acid.	Chlorin.	Nitrogen.
Grapes, 1,000 lbs	....	5.00	1.00	1.52	.10	1.70
Crop of 10,000 lbs	....	50.00	10.00	15.20	1.00	17.00
Seeds, 646 lbs	....	1.48	.....	5.75	......	.....
Flesh, 9,154 lbs	....	47.44	.....	8.93	......	......
Wood, 2,010 lbs	53.42	15.69	21.60	8.74	.61	.....
Prunes, 1,000 lbs.	3.03	2.66	.13	.53	.01	1.48
Crop of 30,000 lbs	120.90	79.70	3.9[illegible]	15.95	.22	44.40
Pits, 1,635 lbs	8.60	2.06	.52	2.80	.02	10.30
Flesh, 28,365 lbs	112.30	77.64	3.40	13.15	.20	34.10
Apricots, 1,000 lbs	5.16	2.83	.18	.71	.02	2.29
Crop of 30,000 lbs	154.80	84.98	5.45	21.38	.94	68.70
Pits, 1,740 lbs	12.25	1.36	.83	5.36	.19	15.00
Flesh, 28,260 lbs	142.55	83.62	4.65	16.02	.75	53.70
Oranges, 1,000 lbs	4.32	2.11	.99	.53	.04	1.83
Crop of 20,000 lbs	86.40	42.28	19.72	10.60	.80	36.60
Seeds, 240 lbs	6.90	2.74	1.32	1.61	.04	....
Flesh and rind, 19,760 lbs	79.50	39.54	18.40	8.99	.76	.....
Roots, percentage	100.12	15.43	49.89	13.47	.72	.....
Stems, "	100.00	11.69	55.13	17.09	.15	.....
Leaves "	99.91	16.51	56.38	3.27	4.03	.....
Olives, 1,000 lbs	94.63	8.55	2.32	1.18	.23	5.85
Crop of 2,200 lbs	208.18	18.81	5.10	2.59	.50	12.86
Pits, 429 lbs	193.25	6.77	4.01	2.40	.48	9.67
Flesh, 1,771 lbs	14.56	12.04	1.09	.19	.02	3.19
Leaves, 4,400 lbs	190.16	58.05	88.53	20.08	.28	69.90
Wood, 11,000 lbs	123.18	24.46	66.63	14.87	.....	117.67
Wheat, 1,000 lbs. (whole plant)	51.26	9.15	2.30	4.13	1.65	8.75
Crop of 4,800 lbs. (hay)	246.04	43.92	11.04	19.80	7.89	42.00
Grain, 20 bushels	24.00	7.85	.72	11.90	.02	24.00
Straw, 3,600 lbs	222.04	36.07	10.32	7.90	7.87	18.00
Alfalfa, 1,000 lbs	65.00	13.49	22.86	6.43	1.59	12.96
Crop of 12,000 lbs	780.00	161.88	274.32	77.16	19.08	155.52
Sugar beets (fresh), 1,000 lbs	18.73	5.38	3.11	1.61	.86	2.38
Crop of 72,000 lbs	1349.72	387.44	224.08	116.16	61.68	173.40
Roots, 40,000 lbs	287.00	152.00	16.00	36.00	12.00	60.40
Tops, 32,000 lbs	1062.72	235.44	208.08	80.16	49.68	113.00
Ramie, 1,000 lbs	75.19	8.84	23.08	6.46	1.12	12.97
Crop of 14.25 tons	2143.57	251.98	657.82	155.70	51.85	369.70
Leaves, 4.25 tons	1641.35	68.13	566.91	77.13	41.56	206.10
Stalk (without bark), 7.25 tons.	410.48	155.99	71.77	67.71	2.50	105.85
Bark (cuticle and fibre), 2.75 tons	91.74	27.86	19.14	10.86	7.79	57.75
Cotton, 1,000 lbs	54.26	11.00	13.76	7.03	2.58	.....
Crop of 3,200 lbs	173.60	35.26	44.04	22.54	8.27	.....
Leaves, 400 lbs	48.69	7.99	15.03	4.22	2.75	.....
Stems, 1,200 lbs	38.44	9.17	10.58	4.49	2.54	.....
Seeds, 800 lbs	29.37	8.99	3.07	9.74	.48	29.20
Burs, 400 lbs	52.01	7.42	14.16	3.57	2.14	.....
Lint, 400 lbs	5.09	1.69	1.20	.52	.36	.....

AMOUNT OF FERTILIZING MATERIALS CONTAINED IN DIFFERENT CROPS GROWN ON ONE ACRE. (VanSlyke.)

Kind of Crops.	Yield of Grain, Fruit, etc.	Yield of Straw, etc.	Pounds of Nitrogen.	Pounds of Phosphoric Acid.	Pounds of Potash.
Apples	10 to 20 tons.	....	26 to 52	2 to 4	40 to 80
Barley	20 to 40 bushels.	1,350 to 2,700 lbs.	37 to 74	11.5 to 23	34 to 68
Beans	20 to 40 bushels.	1,800 to 3,600 lbs.	50 to 100	20 to 40	35 to 70
Buckwheat	15 to 30 bushels.	1,200 to 2,400 lbs.	26.5 to 53	10.5 to 21	30 to 60
Cabbage	15 to 30 tons.	....	100 to 200	35 to 70	135 to 270
Clover, crimson (green)	....	7½ to 15 tons.	65 to 130	20 to 40	70 to 140
Clover, red, hay	....	1 to 2 tons.	41 to 82	9 to 18	44 to 88
Corn (grain alone)	30 to 60 bushels.	2,500 to 5,000 lbs.	42 to 84	16 to 32	17 to 34
Grapes	1 to 2 tons.	3,000 to 6,000 lbs.	7 to 14	18 to 36	26 to 52
Hops (whole crop)	1,600 to 3,200 lbs.	....	40 to 80	28 to 56	32 to 64
Mixed hay	....	1 to 2½ tons.	28 to 70	7 to 17.5	31 to 77
Oats	30 to 60 bushels.	1,600 to 3,200 lbs.	30 to 60	11 to 22	25 to 50
Onions	350 to 700 bushels.	....	28 to 56	10 to 20	20 to 40
Pears	8 to 16 tons.	....	16 to 32	5 to 10	13 to 26
Peas	15 to 30 bushels.	1,500 to 3,000 lbs.	54 to 108	16.5 to 33	26 to 52
Plums	4 to 8 tons.	....	15 to 30	2 to 4	20 to 40
Potatoes	100 to 200 bushels.	750 to 1,500 lbs.	16.5 to 33	10 to 20	31 to 62
Rye	15 to 30 bushels.	2,100 to 4,200 lbs.	24.5 to 49	13 to 26	21 to 42
Sugar beets	300 to 600 bushels.	3,000 to 6,000 lbs.	55 to 110	20 to 40	95 to 190
Timothy hay	....	1 to 2 tons.	25 to 50	10 to 20	30 to 60
Tobacco	800 to 1,600 lbs leaves.	700 to 1,400 lbs. stems.	38 to 76	8 to 16	100 to 200
Tomatoes	5 to 10 tons.	....	16 to 32	10 to 20	27 to 54
Turnips	350 to 700 bushels.	2¼ to 5 tons.	40 to 80	26 to 52	90 to 180
Wheat	15 to 30 bushels.	1,600 to 3,200 lbs.	31 to 62	10 to 20	13 to 26

MINIMUM AMOUNT OF FARMYARD MANURE required to replace the Ingredients abstracted from the Soil by an Acre of Different Crops. (McConnell.)

Wheat	5 tons.	Turnips	15 tons.
Barley	5	Swedes	10
Oats	5	Mangolds	20
Meadow hay	8	Potatoes	10
Red clover	12	Cabbage	25
Beans	10	Carrots	10

AMOUNT AND QUALITY OF MANURE PRODUCED BY STOCK.

The various classes of farm animals will produce about the following quantities of solid and liquid manure during a year, viz.:

	Solid Manure.	Liquid Manure.
Horse	12,000 lbs.	3,000 lbs.
Cow	20,000 "	8,000 "
Sheep	760 "	380 "
Pig	1,800 "	1,200 "

Since a considerable portion of the manure is lost while the animal is working or is out-doors, the quantities secured in the manure-pile will not come up to these figures.

The quantities of urine voided by farm animals during twenty-four hours are on the average as follows, according to Wilckens: cows, 15–20 lbs.; horses, 20–27 lbs.; sheep, 2 lbs.; swine, 7–9 lbs. The capacity for liquid manure-tanks or cisterns intended to hold the fluid excrements of a herd of a certain size may readily be calculated on a basis of these figures (see tables on p. 182). 6000 lbs. (about 720 gallons) of urine per 1000 lbs. live weight of cattle, is a liberal estimate.

The quality of the manure produced will depend on the character of the feeding and the kind of stock kept. Rich feeding produces a rich manure, since, as shown in the table given below, only a relatively small portion of the valuable fertilizing ingredients of the food is retained in

the bodies of the animals, or is taken away in the products sold. Rich feeding, therefore, has a beneficial influence in two directions, larger yields of products being obtained, and a better quality of manure being produced.

COMPOSITION, AMOUNT, AND VALUE OF MANURE Produced by Different Kinds of Farm Animals.

(Results of experiments conducted at Cornell University Experiment Station.)

	Analysis and Value per Ton of Manure.					Amount and Value per 1000 lbs. Live Weight per Day.		
	Water.	Nitrogen.	Phosphoric Acid.	Potash.	Value per Ton.*	Pounds per Day.	Value per Day.*	Value per Year.*
	Per ct.	Per ct.	Per ct.	Per ct.			Cents.	
Sheep ..	59.52	.77	9.39	.59	$3.30	34.1	7.2	$26.09
Calves	77.73	.50	.17	.53	2.18	67.8	6.7	24.45
Pigs . .	74.13	.84	.39	.32	3.29	83.6	16.7	60.88
Cows ...	75.25	.43	.29	.44	2.02	74.1	8.0	29.27
Horses .	48.69	.49	.26	.48	2.21	48.8	7.6	27.74

QUANTITIES OF NITROGEN AND ASH CONSTITUents Voided by Animals or Obtained in Animal Products. (LAWES and GILBERT.)

	Percentage of Nitrogen.				Percentage of Ash Constituents.	
	Obtained as Animal Product.	Voided as Solid Excrement.	Voided as Liquid Excrement.	In Total Excrement.	Obtained as Live Weight or Milk.	Voided as Excrement or Perspiration.
Horse at rest ..	None.	43.0	57.0	100.0	None.	100.0
Horse at work.	None.	29.4	70.6	100.0	None.	100.9
Fattening oxen .	3.9	22.6	73.5	96.1	2.3	97.7
Fattening sheep.	4.3	16.7	79.0	95.7	3.8	96.2
Fattening pigs.	14.7	22.0	63.3	85.3	4.0	96.0
Milking cows....	24.5	18.1	57.4	75.5	10.3	89.7

* Valuing nitrogen at 15 cents, phosphoric acid at 6 cents, and potash at 4½ cents per pound.

PERCENTAGE COMPOSITION OF COMMERCIAL FERTILIZING MATERIALS. (BEAL.)

Name.	Moisture.	Nitrogen.	Potash.	Phosphoric Acid.			Lime.
				Soluble.	Reversed.	Total.	
Algæ (*Lyngbia majuscula*).	16.26	4.25	.79	.....	.....	.19	2.06
Ammonite	5.88	11.33	.....	.....	.....	3.43	.....
Apatite.	.....	.....	.....	.....	.....	36.08	.....
Ashes, anthracite coal	.....	.....	.10	.....	.....	.10	.....
" bituminous "	.....	.....	.40	.....	.....	.40	.....
" lime-kiln.	15.45	.....	1.20	.....	.....	1.14	48.50
" wood, leached	30.22	.....	1.27	.....	.....	1.51	28.08
" " unleached	12.50	.....	5.25	.....	.....	1.70	34.00
Bat guano	40.09	8.20	1.31	2.37	1.24	3.80	.....
Bone-ash.	7.00	.....	.....	.....	.....	35.89	44.89
Bone-black	4.60	.....	.....	.....	.....	28.28	.....
" " dissolved	.....	.....	.....	15.40	1.30	17.00	.....
Bone meal	7.50	4.05	.....	.40	7.60	23.25	.....
" " dissolved	.....	2.60	.....	13.53		17.60	.....
" " free from fat	.....	6.20	.....	.....	.....	20.10	.....
" " from glue factory	.....	1.70	.....	.....	.....	29.90	.....
Carnallite.	.....	.....	13.60	.....	.....	.....	.....
Caribbean guano	7.31	.....	.....	.....	.....	26.77	39.95
Castor pomace	9.50	5.50	1.10	.....	.....	1.75	.....
Cotton-hull ashes	7.80	.....	22.75	1.25	6.50	8.85	9.60
Cotton-seed meal, decort	7.75	6.79	1.77	.....	.....	2.88	.....
" " " undecort	.....	4.30	1.50	.....	.....	3.10	.....
Cuba guano	24.27	1.67	.....	.....	.....	13.35	.....
Dried blood	12.50	10.52	.....	.....	.....	1.91	.....
Dried fish	12.75	7.25	.....	.55	2.60	8.25	.....
Eel-grass (*zostera marina*)	81.19	.35	.32	.....	.....	.07	.51
Gas lime	22.28	.....	.....	.....	.....	.....	43.66
Horn and hoof waste	10.17	13.25	.....	.....	.....	1.83	.....
Kainit	3.20	.....	13.54	.....	.....	.....	1.15
Kelp (*laminaria*)	87.75	.20	.24	.....	.....	.06	.40
Kieserite	22.70	.....	.....	.....	.....	.....	2.82
Krugite	4.82	.....	8.42	.....	.....	.....	12.45
Lobster shells	7.27	4.50	.....	.....	.....	3.52	22.24
Marls, Kentucky	1.50	.....	.1–3	.....	.....	.2	3–34
" Maryland and Virginia	1.50	.....	.2–5	.....	.....	.0–2	0–40
" New Jersey green sand	1.50	.....	3.5–7	.....	.....	.1–4	1–9
" North Carolina	1.50	.....	.2–1.5	.....	.....	0–.4	5–45
Meat scrap	12.09	10.44	.....	.....	.....	2.07	.....
Mona Island guano	13.32	.76	.....	.....	7.55	21.88	37.49
Muck.	50.00	1.10	.15	.....	.....	.10	.....
Mud, salt	60.00	.40	.35	.....	.....	.10	.90
Muriate of potash	2.00	.....	51.48	.....	.....	.....	.....
Navassa phosphate	7.60	.....	.....	.....	.....	34.27	37.45
Nitrate of soda	1.40	15 70	.....	.....	.....	.....	.....
Oleomargarine refuse	8 54	12.12	.....	.....	.....	.88	.....

PERCENTAGE COMPOSITION OF COMMERCIAL FERTILIZING MATERIALS.—*Continued.*

Name.	Moisture.	Nitrogen.	Potash.	Phosphoric Acid.			Lime.
				Soluble.	Reversed.	Total.	
Oyster-shell lime*	15.00	.....	.05	.....	.....	.18	55.00
Peat	61.50	.85	.18	.....	.....	.08	.....
Peruvian guano	14.81	7.35	2.65	3.20	4.10	15.30	.....
Phosphates, Florida	2.25	.....	.....	.....	.....	24 50	28.50
Plaster, pure†	.....	.....	.....	.....	.....	.....	20.93
Seaweed	81.90	.29	.40	.....	.....	.08	.....
" ashes	1.47	.....	.92	.....	.....	.30	6.06
" mixed	81.50	.73	1.50	.....	.....	.18	.23
Sewage sludge, precipitated	88.49	.05	.05	.....	.....	.10	1.58
Soot	5.54	.....	1.83	.....	.....	.....	.....
S. Carolina rock, dissolved	.....	.....	.....	11.60		15.20	.....
" " " ground	1.50	.....	.....	.27	.07	28.03	41.87
Spent tan-bark ashes	3.61	.....	2.04	.....	.....	1.61	33.46
Sumac waste	63.06	1 19	3.25	.....	.....	.....	1.14
Sulfate of ammonia	1.00	20.50	.....	.....	.....	.....	.....
Sulfate of potash and magnesia	4.75	.....	25.50	.....	.....	.....	2.57
Sulfate of potash, high grade	2.54	.....	33.40	.....	.....	.....	.....
Sylvanite	7.25	.....	16.65	.....	.....	.....	.....
Tankage	10.00	6.70	.....	.30	5.10	11.80	.....
Thomas slag	1.45	.....	.....	.00	3.06	23.49	48.66
Tobacco stalks	6.18	3.71	5.02	.....	.....	.65	2.22
" stems	10.00	2.35	8.20	.....	.....	.70	4.20
Wool washings	.....	.....	3.92	.....	.....	.....	.....
Wool waste	15.80	6.50	‡1.20	.....	.....	.35	.11
Composition of Farm Manures.							
Barnyard manure, average	68.87	.49	.43	.....	.....	.32	.....
Cattle excrement, solid, fresh	.....	.29	.10	.....	.....	.17	.....
Cattle urine, fresh	.....	.58	.49	.....	.....	.....	.....
Hen manure, fresh	60.00	1.10	.56	.....	.....	.85	.....
Horse excrement, solid	.....	.44	.35	.....	.....	.17	.....
Horse urine, fresh	.....	1.55	1.50	.....	.....	.....	.....
Human excrement, solid	77.20	1.00	.25	.....	.....	1.09	.....
Human urine	95.90	.60	.20	.....	.....	.17	.....
Pigeon manure, dry	10.00	3.20	1.00	.....	.....	1.90	2.10
Poudrette, night soil	50.00	.80	.30	.....	.....	1.40	.80
Sheep excrement, solid, fresh	.....	.55	.15	.....	.....	.31	.....
Sheep urine, fresh	.....	1.95	2.26	.....	.....	.01	.....
Stable manure, mixed	73.27	.50	.60	.....	.....	.30	.....
Swine excrement, solid, fresh	.....	.60	.13	.....	.....	.41	.....
Swine urine, fresh	.....	.43	.83	.....	.....	.07	.....

* 18.5 per cent carbonate.

† Nova Scotia plaster contains 94 per cent pure gypsum and 4 per cent carbonate of lime; Onondaga and Cayuga, 65–75 per cent gypsum and 18–28 per cent carbonate of lime.

‡ Sometimes as high as 5 per cent.

EXHAUSTION OF FERTILIZERS. (Scotch Authority.)

ON CULTIVATED CLAY LOAM.

Kind of Fertilizer.	Exhausted [in Years].	Per Cent remaining in the Soil Unexhausted at End of Each of First Six Years.					
		1	2	3	4	5	6
Lime	12	80	65	55	45	35	25
Bone meal	5	60	30	20	10	..	..
Phosphatic guanos	5	50	30	20	10	..	..
Dissolved bones and plain superphosphates	4	20	10	5	..	..	..
High-grade ammoniated fertilizers, guano, etc.	3	30	20	..	..	..	..
Cotton-seed meal	5	40	30	20	10	..	..
Stable manure	5	60	30	20	10	..	..

ON CULTIVATED LIGHT OR MEDIUM SOILS.

Kind of Fertilizer.	Exhausted [in Years].	1	2	3	4	5	6
Lime	10	75	60	40	30	20	15
Bone meal	4	60	30	10	..	..	..
Phosphatic guanos	4	50	20	10	..	..	..
Dissolved bones and plain superphosphate	3	20	10	5	..	..	..
High-grade ammoniates, guanos.	3	30	20	..	..	..	..
Cotton-seed meal	4	40	30	20	10	..	..
Stable manure	4	60	30	10	..	..	..

ON CULTIVATED PASTURE LAND.

Kind of Fertilizer.	Exhausted [in Years].	1	2	3	4	5	6
Lime	15	80	70	60	50	45	40
Bone meal	7	60	50	40	30	20	10
Phosphatic guanos	6	50	40	30	20	10	..
Dissolved bone, etc	4	30	20	10	..	..	..
High-grade ammoniated guanos	4	30	20	10	..	..	..
Cotton-seed meal	5	40	30	20	10	..	..
Stable manure	7	60	50	40	30	20	10

Sulfate of ammonia, nitrate of soda, sulfate, nitrate, and muriate of potash are generally held to be entirely exhausted by the crops grown the season of their application.

EQUIVALENT QUANTITIES OF FERTILIZING MATERIALS. (Wheeler and Hartwell.)

For	May be Substituted any One of these Materials.		
100 lbs. nitrate of soda	76 lbs. sulfate of ammonia	141 lbs. dried blood	235 lbs. cotton-seed meal.
100 lbs. sulfate of ammonia	132 lbs. nitrate of soda	186 lbs dried blood	311 lbs. cotton-seed meal
100 lbs dried blood	71 lbs. nitrate of soda	54 lbs. sulfate of ammonia	167 lbs. cotton-seed meal
100 lbs. cotton-seed meal	43 lbs. nitrate of soda	32 lbs. sulfate of ammonia	60 lbs. dried blood
100 lbs. diss. phosphate rock	76 lbs. diss. bone black	33 lbs. double superphosphate	
100 lbs. diss. bone black	131 lbs. diss. phosphate rock	43 lbs. double superphosphate	
100 lbs. double superphosphate	308 lbs diss. phosphate rock	235 lbs. double superphosphate	
100 lbs. tankage	39 lbs. nitrate of soda and 38 lbs. phosphate rock. 29 lbs. sulfate of ammonia and 38 lbs. phosphate rock. 55 lbs. dried blood and 38 lbs. phosphate rock. 91 lbs. cotton-seed meal and 38 lbs. phosphate rock. 80 lbs. dry ground fish and 14 lbs. phosphate rock 33 lbs. nitrate of soda and 4.5 lbs. fine-ground bone.		
100 lbs. dry ground fish	48 lbs. nitrate of soda and 31 lbs. diss. phosphate rock 37 lbs. sulfate of ammonia and 31 lbs. diss. phosphate rock. 68 lbs. dried blood and 31 lbs. diss. phosphate rock 113 lbs. cotton-seed meal and 31 lbs. diss. phosphate rock. 80 lbs. tankage and 17 lbs. nitrate of soda. 36 lbs. fine ground bone and 44 lbs. nitrate of soda.		
100 lbs. fine-ground bone	13 lbs. nitrate of soda and 85 lbs. diss. phosphate rock. 10 lbs. sulfate of ammonia and 85 lbs. diss. phosphate rock. 18 lbs. dried blood and 85 lbs. diss. phosphate rock. 30 lbs. cotton-seed meal and 85 lbs. diss. phosphate rock. 33 lbs. tankage and 72 lbs. diss. phosphate rock. 27 lbs. dry ground fish and 76 lbs. diss. phosphate rock		

PROPORTION OF PLANT FOOD RECOMMENDED FOR CROPS. (Virginia Exp. Station.)

Crop.	Nitrogen.	Phosphoric Acid.	Potash	Crop.	Nitrogen.	Phosphoric Acid.	Potash
	%	%	%		%	%	%
Alfalfa	1	8	10	Oats	4	9	6
Barley	4	7	8	Peanuts ...	2	10	10
Buckwheat .	4	8	9	Potatoes ..	4	7	10
Cabbage ...	6	7	9	Rye	4	9	5
Clover	1	8	10	Tobacco ...	5	6	10
Corn	3	8	6	Tomatoes ..	4	6	7
Cotton	3	8	4	Wheat	3	8	4

VALUATION OF MANURES AND FERTILIZERS.

The valuation of fertilizing ingredients shown below (see p. 159) is the one agreed upon by a number of Eastern experiment and fertilizer control stations after a careful study of the retail prices of crude products of fertilizers during the six months prior to March 1, 1908. It expresses the commercial value of the fertilizers, and not their agricultural value; the latter will vary according to the requirements of the land and the character of the crops grown. Fertilizers are sold in States having fertilizer control, on the basis of a guarantee of a minimum content of potash, phosphoric acid, and nitrogen, singly or combined, and it is the office of the fertilizer control stations to watch that goods offered for sale in their respective States are up to the guarantee. Farmers living in States where fertilizer laws have been enacted (Alabama, Arkansas, California, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Mississippi, Missouri, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Vermont, Virginia, West Virginia, Wisconsin) should only buy fertilizers on guarantee, and should examine the fertilizer bulletins published by their respective stations to ascertain that the goods put on the market are not below the guarantee, and that the valuation price is not below the selling price of the article. Where a reasonable suspicion of fraud exists, apply to the director of the experiment station for information concerning the goods offered for sale or the firm placing them on the market.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS, 1913.

Adopted by Eastern Experiment Stations for estimating the value of mixed commercial fertilizers.

	Cents per lb
Nitrogen—	
in nitrates	18.5
in ammonia salts	18.5
Organic Nitrogen—	
in dry and fine-ground fish, meat, and blood	20
in fine bone and tankage and in mixed fertilizers	19
in coarse bone and tankage	15
in cotton seed meal and castor pomace	20
Phosphoric Acid—	
soluble in water	4.5
soluble in neutral ammonium-citrate solution	4
in dry fine-ground fish, bone, and tankage	4
in coarse fish, bone, tankage, and ashes	3.5
in cotton-seed meal and castor pomace	4
in mixed fertilizers, if insoluble in ammonium-citrate solution	2
Potash—	
as high-grade sulfate, and in forms free from muriate	5½
as muriate	4½
in cotton-seed meal and castor pomace	5

The manurial constitutents contained in feeding stuffs may be valued as follows:

Organic nitrogen	20
Phosphoric acid	4
Potash	5

CONVERSION TABLE FOR CALCULATING FERTILIZING INGREDIENTS.

Amount of	Multiplied by	Gives Corresponding Amount of
Nitrogen	1.214	Ammonia.
"	6.07	Nitrate of soda.
"	4.7	Sulfate of ammonia.
Ammonia	.824	Nitrogen.
"	3.882	Sulfate of ammonia.
"	3.147	Chlorid of ammonia.
"	3.706	Nitric acid.
"	5.0	Nitrate of soda.
"	5.15	Protein.
Nitrate of soda	.165	Nitrogen.
" " "	.2	Ammonia.
Sulfate of ammonia	.212	Nitrogen.
" " "	.258	Ammonia.
Potash (anhydrous)	1.85	Sulfate of potash.
"	1.583	Muriate of potash.
Sulfate of potash	.54	Potash.
Muriate of potash	.632	"
Phosphoric acid (anhydrous).	2.183	Tri-calcium phosphate.
" "	1.915	Di-calcium phosphate.
" "	1.648	Mono-calcium phosphate.
Mono-calcium phosphate	1.325	Tri-calcium phosphate.
Di-calcium phosphate.	1.565	" " "
Tri-calcium phosphate	.459	Phosphoric acid.
Lime (calcium oxid)	1.845	Tri-calcium phosphate.
"	1.786	Carbonate of lime.
Chlorin	1.648	Sodium chlorid.

PRICES OF NITRATE OF SODA ON THE AMMONIATE BASIS. (Chilean Nitrate Works.)

Figured on Basis 380 lbs. Ammonia in One Ton Nitrate of Soda.

Price per Cwt. of Nitrate.	Price per Ton of Nitrate.	Price Ammonia per Lb. as Nitrate.	Equivalent Price Ammonia per Ton Unit.	Equivalent Cost of Nitrogen per Lb.
$1.80	$36.00	$0.0947	$1.894	$0.115
1.85	37.00	0.0973	1.946	0.118
1.90	38.00	0.1000	2.000	0.122
1.95	39.00	0.1026	2.052	0.125
2.00	40.00	0.1052	2.104	0.128
2.05	41.00	0.1078	2.156	0.131
2.10	42.00	0.1105	2.210	0.134
2.15	43.00	0.1131	2.262	0.137
2.20	44.00	0.1157	2.314	0.140
2.25	45.00	0.1184	2.368	0.144
2.30	46.00	0.1210	2.420	0.147
2.35	47.00	0.1236	2.472	0.150
2.40	48.00	0.1263	2.526	0.153
2.45	49.00	0.1289	2.578	0.156
2.50	50.00	0.1315	2.630	0.159

XI. AGRICULTURAL ENGINEERING.

REASONS FOR TILE-DRAINING LAND.

(CHAMBERLAIN.*)

Land should be drained, because:

1. Tile drainage makes all tillage and harvesting operations easier and more rapid, physically and mechanically.

2. Drainage removes both the excess surface-water, and the surplus water in the soil and the subsoil.

3. Drainage prevents loss of fertility by surface wash.

4. Drainage will add fertility to the soil with each rainfall.

5. Drainage helps to warm the soil as well as to dry it, giving best conditions for plant growth.

6. Drainage lengthens the season of tillage, crop, growth, and harvest.

7. Drainage increases the extent of root pasturage.

8. Drainage helps to disintegrate the soil and make pulverization possible.

9. Drainage greatly diminishes the effect of frost in heaving out wheat, clover, etc., in winter and spring.

10. Drainage on clayey soils helps the crops to resist drought better.

11. Drainage often, though not always, diminishes the suddenness and violence of floods.

12. Drainage, both open and with tiles, improves the health of a region.

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*Tile Drainage, by W. I. Chamberlain, Medina, Ohio, 1891, 35 cents.

NUMBER OF RODS AND OF TILES PER ACRE, WITH DRAINS AT VARIOUS DISTANCES APART. (SCOTT.)

Distance between the Drains.	Rods (5½ Yards) per Acre.	12-inch Tile.	13-inch Tile.	14-inch Tile.	15-inch Tile.
Feet.					
15	176	2904	2680	2489	2323
18	146	2420	2234	2074	1936
21	125	2074	1915	1778	1659
24	110	1815	1676	1555	1452
27	97	1613	1480	1383	1290
30	88	1452	1340	1244	1161
33	80	1320	1219	1131	1056
36	72	1210	1117	1037	968
39	67	1117	1031	957	893
42	62	1037	958	888	829

SIZE OF TILE PIPES

Required for Draining under Average Conditions.

(WARING.)

The drains being laid four feet, or more, deep, and laid on a well-regulated fall of three inches in a hundred feet:

For	2 acres	....	1½-inch pipes
"	8 "	....	2½ " "
"	20 "	....	3½ " "
"	40 "	.... two	3½ " "
"	50 "	....	6 " "
"	100 "	....	8 " "

These drains will remove the water fast enough for all practical purposes, even after heavy storms; if the pipes are securely laid, the drains will only be benefited by the occasional cleaning they will receive when running "more than full."

Table of Size of Tile Pipe of Main Drain.

(McConnell.)

Fall.	Acres Drained.					
	3-inch Tile.	4-inch Tile.	6-inch Tile.	8-inch Tile.	10-inch Tile.	12-inch Tile.
1 foot in 20..........	18.6	26.8	74.4	150.0	270.0	426.0
1 " " 30..........	15.1	21.8	60.4	128.0	220.8	346.0
1 " " 40..........	12.9	18.6	51.6	108.8	189.6	298.4
1 " " 50..........	11.9	17.0	47.7	98.0	170.4	269.0
1 " " 60..........	10.9	15.6	43.4	90.0	156.0	246.0
1 " " 70	10.0	14.5	39.9	83.0	144.4	228.1
1 " " 80..........	9.3	13.4	37.2	77.0	135.0	213.0
1 " " 90..........	8.1	12.6	35.0	72.5	127.0	200.5
1 " " 100..........	7.3	11.9	33.1	69.2	120.6	190.5
1 " " 150..........	6.7	9.5	26.6	56.0	97.3	154.4
1 " " 200..........	5.7	8.2	22.8	48.0	83.9	132.5
1 " " 250..........	5.1	7.5	20.4	42.4	74.4	117.0
1 " " 300	4.6	6.9	18.4	38.2	65.5	107.0
1 " " 400.........	4.1	5.9	16.5	32.6	60.3	90.7
1 " " 500..........	3.7	5.2	14.8	30.1	54.0	81.6
1 " " 600..........	3.3	4.7	13.3	28.0	48.6	74.0
1 " " 800..........	2.9	4.1	11.4	24.0	41.9	65.0
1 " " 1000..........	2.6	3.7	10.2	21.2	37.2	56.0
1 " " 1500....	2.1	3.0	8.5	16.8	30.8	47.0
1 " " 2000..........	1.9	2.8	7.4	15.0	25.0	40.8

Rule for Obtaining Size of Main Pipes.—Multiply the square root of the number of small drains (of fair average length) by the diameter of small pipes; the quotient gives the diameter of main.

If the distance apart of drains in feet be denoted by F, that in links by L, and the length of drains in chains per acre by C, then

$$C = \frac{660}{F} = \frac{1000}{L}.$$

NUMBER OF ACRES WHICH A TILE OF A GIVEN DIAMETER AND PER CENT GRADE WILL DRAIN WHEN USED AS AN OUTLET. (Elliott.)

Table 1.—Discharge of Tile from 4 to 20 inches in Diameter on a Grade of 1 foot per 100 feet.

Diameter of Tile, Inches.	Discharge in Cubic Feet per Second.	Diameter of Tile, Inches.	Discharge in Cubic Feet per Second.
4	0.16	12	3.40
6	0.49	15	6.29
8	1.11	18	10.37
9	1.53	20	13.85
10	2.05		

Table 2.—Grades per 100 feet, and their Square Roots.

Grade per 100 Feet in Feet.	Grade in Inches (approximated).	Square Root of Grade.	Grade per 100 Feet in Feet.	Grade in Inches (approximated).	Square Root of Grade.
0.04	½	0.200	0.40	4¾	0.632
.05	⅝	.224	.45	5⅜	.671
.06	¾	.245	.50	6	.707
.08	⅞	.283	.55	6⅝	.742
.09	1	.300	.60	7⅛	.775
.10	1⅛	.316	.65	7¾	.806
.12	1½	.346	.70	8⅜	.837
.14	1¾	.374	.75	9	.866
.16	2	.400	.80	9⅝	.894
.18	2¼	.424	.85	10¼	.922
.20	2½	.447	.90	10¾	.949
.25	3	.500	.95	11¼	.975
.30	3⅝	.548	1.00	12	1.000
.35	4¼	.592			

To determine the number of acres that a tile main of given size and grade will drain, multiply the discharge of the tiles, according to size (see Table 1), by the square root of the grade upon which it is proposed to lay the main (Table 2). When it is desired that the main shall carry 1 inch in depth per acre in twenty-four hours, multiply this result by 24; if one-half inch, multiply by 48; if one-fourth inch, multiply by 96. (Farmers' Bulletin, No. 40.)

NUMBER OF ACRES DRAINED BY TILES REMOVING 1/4-INCH DEPTH OF WATER IN 24 HOURS.

(ASHBAUGH.)

Grades.		Diameters of Tile Drains, Inches.										
Per cent.	In. per Rod.	3	4	6	8	10	12	15	18	20	22	24
0.03	1/16	....	....	....	....	37	59	109	159	205	254	319
0.05	3/32	....	5	13	28	49	75	131	219	264	332	411
0.10	3/16	4	7	19	40	69	109	186	289	373	471	582
0.15	9/32	4	9	24	49	85	132	232	355	458	577	713
0.20	3/8	5	10	28	56	97	153	264	410	529	667	823
0.30	9/16	6	12	33	69	119	188	322	502	648	808	1008
0.40	13/16	7	14	39	79	138	216	371	580	748	942	1165
0.50	1	8	16	44	89	154	246	416	648	838	1050	1300
0.60	1 3/16	9	17	48	97	169	266	457	710	911	1154	1422
0.70	1 3/8	10	19	50	105	182	287	488	768	988	1242	1549
0.80	1 9/16	10	20	55	114	195	307	526	822	1059	1332	1645
0.90	1 3/4	10	21	59	119	207	326	558	872	1123	1414	1747
1.00	2	11	22	62	126	218	343	589	917	1176	1495	1838
1.50	3	13	28	75	153	267	419	722	1123	1450	1824	2256
2.00	4	15	31	88	178	309	485	832	1297	1676	2110	2594
3.00	5 15/16	19	39	107	216	377	593	1020	1589	1957	2592	
4.00	7 15/16	22	45	123	253	437	683	1176				
5.00	9 7/8	25	50	138	280	486	765					
7.50	14 7/8	30	61	169	344							
10.00	19 13/16	35	71	195								

The table is based on Poncelet's formula, and refers to drainage of ground water only. If surface water is also to be removed, as in the case of ponds without other outlets, the tiles will drain safely only one-half to one-third the number of acres given in the table. When a part of the land in the watershed is rolling, not requiring tiling, count only one-third of such rolling land in addition to all of the low, flat land, in getting the size of tiles to remove ground water only.

If it is not practicable to use such a large tile as is required to carry a large amount of surface drainage, a broad shallow depression, cultivated or kept in grass, may be maintained alongside of the drain to carry the surface overflow from heavy rains. A 12-inch tile may thus often be used in place of the expensive 15-inch or 18-inch tile.

NUMBER OF ACRES DRAINED BY OPEN DITCHES.

Depth of Water, 3 feet. Depth of Ditch, at least 4 feet.

Grades.		Average Width of Water, Feet.							
Per cent.	Feet per Mile.	4	6	8	10	15	20	30	50
0.02	1.0	.....	.....	725	970	1570	2240	5300	18400
0.04	2.1	400	690	1000	1360	2250	4700	7470	26100
0.06	3.2	492	850	1260	1690	2770	5770	18400	31900
0.08	4.2	572	980	1460	1950	4820	6670	21400	37400
0.10	5.3	636	1100	1630	2180	5360	7440	23700	41400
0.15	7.8	791	1330	2010	2670	6600	19000	30200	52100
0.20	10.6	905	1560	2310	4720	7870	21800	35000	60300
0.25	13.2	1020	1740	2660	5300	17500	24600	39000	67700
0.30	15.8	1100	1970	2900	5850	19400	26800	42700	74000
0.40	21.1	1300	2290	5050	6740	22200	30800	49400	85700
0.50	26.4	1475	2559	5620	7500	24800	34800	55300	95200
0.60	31.7	1600	2790	6230	16500	27200	37600	60400	
0.70	37.0	1720	3010	6650	17800	29400	41200		
0.80	42.2	1850	4850	7170	19100				
0.90	47.5	1955	5140	7550	20100				
1.00	52.8	2050	5400	7980					

Depth of Water, 5 feet. Depth of Ditch, at least 6½ feet.

Grades.		Average Width of Water, Feet.						
Per cent.	Feet per Mile.	6	8	10	15	20	30	50
0.02	1.0	980	1470	1900	5000	7150	23800	43800
0.04	2.1	1390	2090	2800	7200	20400	33500	62500
0.06	3.2	1710	2560	5100	17600	24700	40800	75500
0.08	4.2	1980	2980	6100	20400	30000	48800	88000
0.10	5.3	2220	5010	7600	23400	33400	54500	98000
0.15	7.8	2720	6300	17100	28700	40500	66700	120000
0.20	10.6	4820	7300	19500	33000	47000	77000	139000
0.25	13.2	5370	16300	21900	37500	53000	86000	155000
0.30	15.8	5900	17900	23900	40700	57000	94000	170000
0.40	21.1	6830	20600	27700	47000	67000		
0.50	26.4	7600	23000	31000				
0.60	31.7	16700	25200	33900				
0.70	37.0	18100	27300					
0.80	42.2	19000						
0.90	47.5	20500						

NUMBER OF ACRES DRAINED BY OPEN DITCHES—
(Continued).

Depth of Water, 7 feet. Depth of Ditch, at least 9 feet.

Grade.		Average Width of Water, Feet.					
Per cent.	Feet per Mile.	8	10	15	20	30	50
0.02	1.0	2300	4700	16600	28000	48000	88500
0.04	2.1	4850	6740	23400	35400	58000	106000
0.06	3.2	5920	17000	29600	43400	72000	129000
0.08	4.2	6940	19100	34200	50000	83000	150000
0.10	5.3	7720	21800	38400	56000	92600	167000
0.15	7.8	19400	27000	47200	68500	112000	202000
0.20	10.6	22400	31300	54200	78700	130000	235000
0.25	13.2	25000	34800	60500	88000	146000	
0.30	15.8	27400	38200	66200	96500		
0.40	21.1	31700	44100				
0.50	26.4	35400					

Depth of Water, 9 feet. Depth of Ditch, at least 11½ feet.

Grade.		Average Width of Water, Feet.				
Per cent.	Feet per Mile.	10	15	20	30	50
0.02	1.0	6550	27800	40800	69500	127000
0.04	2.1	18500	34400	50000	83500	157000
0.06	3.2	22600	41600	61000	103000	193000
0.08	4.2	26300	48300	71000	120000	221000
0.10	5.3	30400	54000	79100	132000	244000
0.15	7.8	37300	66100	96200	162000	298000
0.20	10.6	42900	76200	104000		
0.25	13.2	48000	85300	125000		
0.30	15.8	52500	93200			
0.40	21.1	60800				

The above tables are calculated by Kutter's formula, using a "coefficient of roughness" equal to 0.03, as recommended for channels in moderately good condition, having stones and weeds occasionally. For ditches in first-class condition, the number of acres may be increased about 25 per cent. The tables have

been calculated for ditches having sides with slopes of one foot horizontal to one foot vertical, but are approximately correct for other slopes.

The capacity of the ditches has been made as follows, the ditches to run not more than 8–10 full for the capacities mentioned:

Above the upper heavy line, ¾ in. depth of water per 24 hours.

Between the heavy lines, ½ in. depth of water per 24 hours.

Below the lower heavy line, ¼ in. depth of water per 24 hours.

Local conditions may vary the size needed, and it is necessary to consult a drainage engineer in each case.

ADVICE TO LAND OWNERS ABOUT TO CONSTRUCT DRAINS. (Ashbaugh.)

1. Employ a reliable drainage engineer to make surveys, and plan your system of drainage. Otherwise you are very liable to throw away part of your money.

2. Require from your drainage engineer a complete map or plat of your drains, showing the exact location, sizes, grades, and depths. Remember that your drains will be out of reach (except at much cost and trouble) after they are covered.

3. Make your drains of ample size. Drains which are too small fail when you need them most, in wet seasons.

4. Put your tile down to a good depth. Other ise they will not draw well to any considerable distance. Make them four feet deep in the lowest ground if possible. The extra cost of good depth is small in proportion to the total cost.

5. Have your drainage engineer inspect the work during construction and test the grades of the dr ins and see that the work is well done. Many tile become choked with mud because not laid true.

6. Be sure to protect the outlet. Build a bulkhead wall of brick or stone to hold the end. Also use a piece of iron pipe at the end, if tile is not too large, or for large drains use a few feet of sewer-pipe cemented.

7. If you are obliged to construct an open ditch, make it at least five to seven feet deep, if possible, to give good outlets tor tile, and to avoid choking up.

8. The bottoms of open ditches should be at least three feet wide, and the sides should be given slopes of at least one foot horizontal to one vertical to avoid choking. Dirt should not be piled near the edges of the bank.

POINTS TO NOTE IN PLANNING A DRAINAGE SYSTEM.

1. Character of the land, as swampy, low, sloping, dry, etc., also retentive or open, depth of surface soil, condition of subsoil, etc.

2. Acreage of various kinds just described, their location relative to drains, etc.

3. The outlet, its character, capacity, depth, protection required for tile, etc.

4. Fall or grade for mains, submains, and laterals, with depth of cutting required.

5. Various expedients, such as the use of cut-offs across necks of land, to save distance and gain fall.

6. Your drainage engineer should be competent to handle these problems.

SIZES OF DRAIN-PIPE REQUIRED FOR CULVERTS IN PROPORTION TO CAPACITY AND FALL. (ELDRIDGE.)

	Fall in 100 Feet.		
	3 Inches.	6 Inches.	9 Inches.
	Gallons per Minute.		
6 inches	129	183	224
8 "	265	375	460
9 "	355	503	617
10 "	463	655	803
12 "	730	1033	1273
15 "	1282	1818	2224
18 "	2022	2860	3508
24 "	4152	5871	7202

AREAS FROM WHICH 1/4 INCH OF WATER WILL BE REMOVED IN 24 HOURS BY OUTLET TILE DRAINS OF DIFFERENT DIAMETERS AND LENGTHS WITH DIFFERENT GRADES. (ELLIOTT.)

Diameter of Tile in Inches.	Grade per 100 ft. in Decimals of a Foot (with Approx. Equiv. in Inches).									
	0.05 (⅝ in.).		0.08 (1 in.).		0.10 ($1\frac{3}{16}$ in.).		0.12 (1½ in.).		0.16 (2 in.).	
	Length of Drain in Feet.									
	1000	2000	1000	2000	1000	2000	1000	2000	1000	2000
	Acres of Land Drained.									
5.....	17.7	14.0	19.1	15.7	19.8	16.7	20.6	17.6	22.1	19.4
6.....	28.0	22.2	29.9	24.8	31.2	26.4	32.5	27.8	34.8	30.5
7.....	41.1	32.7	44.1	36.4	45.9	38.7	47.7	40.8	51.1	44.8
8.....	57.3	45.6	61.4	50.7	64.0	53.9	66.5	57.0	71.2	62.6
9.....	76.5	61.2	82.2	68.1	85.6	72.3	89.1	76.3	95.3	83.8
10.....	99.5	79.5	106.7	88.5	111.2	94.0	115.6	99.2	123.9	108.9
12.....	156.1	124.9	167.7	139.3	174.8	147.9	181.7	156.2	194.6	171.6
14.....	228.7	183.7	245.3	204.3	256.1	217.4	265.8	229.7	284.9	251.7
16.....	317.8	255.9	341.4	284.6	355.4	302.5	369.5	319.7	396.3	350.4
18.....	424.9	342.5	456.4	381.3	475.7	405.5	494.4	428.1	529.1	470.1
20.....	551.6	444.9	591.5	495.8	616.4	526.7	640.4	556.6	686.3	610.5

Diameter of Tile in Inches.	Grade per 100 ft. in Decimals of a Foot (with Approx. Equiv. in Inches).									
	0.20 (2⅜ in.).		0.25 (3 in.).		0.30 (3⅝ in.).		0.40 (4⅞ in.).		0.50 (6 in.).	
	Length of Drain in Feet.									
	1000	2000	1000	2000	1000	2000	1000	2000	1000	2000
	Acres of Land Drained.									
5.....	23.5	20.9	25.1	22.7	26.7	24.5	29.5	27.5	32.0	30.3
6.....	37.0	33.0	39.6	35.9	42.0	38.6	46.4	43.5	50.5	47.8
7.....	54.3	48.5	58.0	52.8	61.6	56.7	68.2	63.8	74.0	70.1
8.....	75.6	67.7	80.9	73.6	85.8	79.0	95.0	89.1	103.3	98.0
9.....	101.4	90.7	108.4	98.6	114.9	106.0	127.0	119.4	138.1	131.3
10.....	131.6	117.9	140.6	128.1	149.3	137.6	165.2	155.3	179.2	170.5
12.....	206.8	185.6	221.1	201.8	234.5	216.9	259.2	244.1	281.8	268.6
14.....	302.5	272.2	323.5	296.1	343.5	318.1	379.7	358.2	412.9	393.9
16.....	420.6	379.1	449.9	412.2	477.4	442.9	527.8	498.4	573.7	548.8
18.....	562.2	508.1	601.8	552.5	638.1	593.7	705.2	668.0	767.4	735.1
20.....	729.2	660.3	780.0	718.2	826.9	771.1	914.7	867.8	994.5	954.6

Three feet of soil above the top of the drain has been assumed. The grade, length of drain, and openness of soil are important factors in the capacity of a tile drain for discharging soil-water.

RISE OF THE SLOPE FOR 100 FEET. (WARING.)

Table I. gives the rise of the slope for 100 feet of the horizontal measurement.

Table II., the rise of the slope for 100 feet of its own length.

Table No. I.				Table No. II.			
Deg.	Feet.	Deg.	Feet.	Deg.	Feet.	Deg.	Feet.
5	8.749	50	119.175	5	8.716	50	76.604
10	17.633	55	142.815	10	17.365	55	81.915
15	26.795	60	173.205	15	25.882	60	86.602
20	36.397	65	214.451	20	34.202	65	90.631
25	46.631	70	274.748	25	42.262	70	93.969
30	57.735	75	373.205	30	50	75	96.593
35	70.021	80	567.128	35	57 358	80	98.481
40	83.910	85	1143.010	40	64.279	85	99.619
45	100			45	70.711		

Example.—If the horizontal measurement is 100 feet, and the slope is at an angle of 10°, the rise will be 17.633 feet.

If the sloping line (at an angle of 15°) is 100 feet, it rises 25.882 feet.

QUANTITY OF EARTH REMOVED PER ROD OF DRAINS OF VARIOUS DIMENSIONS. (SCOTT.)

Depth of Drain, Feet.	Mean Width of Drains.											
	In. 7	In. 8	In. 9	In. 10	In. 11	In. 12	In. 13	In. 14	In. 15	In. 16	In. 17	In. 18
	Cubic Yards.											
2½	0.89	1.02	1.14	1.27	1.40	1.53	1.65	1.78	1.91	2.04	2.16	2.29
3	1.07	1.22	1.37	1.53	1.68	1 83	1.98	2.14	2.29	2.24	2.60	2.75
3½	1.25	1.42	1.60	1.78	1.96	2.14	2.32	2.49	2.67	2.85	3.03	3.21
4	1.42	1.63	1.83	2.04	2.24	2.44	2.65	2.85	3.05	3.26	3.46	3.66
5	1.78	2.03	2.29	2.54	2.80	3.05	3.31	3.56	3.82	4.07	4.33	4.58

"If a 4-ft. drain be cut 14 in. wide at top and 4 in. at bottom, the mean width will be 9 in., and the quantity of earth excavated in cutting each rod will be 1.83 cubic yards; if

the same drain be cut 18 in. at top and 8 in. at bottom, the mean width will be 13 in., and 2.65 cubic yards of earth will have to be removed in cutting each rod: so that if the digging of the drain costs 6 cents per cubic yard of earth moved the narrow drain will cost 11 cents per rod, and the other nearly 16 cents per rod, showing the cost to be one half larger, quite unnecessarily.

"The same table will be found useful in helping to fix the relative prices of deep and shallow drains; but it must be recollected that the deeper drains will be increased in cost not only by reason of the greater quantity of earth which has to be moved, but also because of the increased labor of lifting the earth to the surface from a greater depth."

LIMIT OF SIZE OF TILE TO GRADE AND LENGTH.

Size of Tile in Inches.	Minimum Grade per 100 Feet.	Limit of Length in Feet.	Size of Tile in Inches.	Minimum Grade per 100 Feet.	Limit of Length in Feet.
3	.09	800	8	.05	3000
4	.05	1600	9	.05	3500
5	.05	2000	10	.04	4000
6	.05	2500	11	.04	4500
7	.05	2800	12	.04	5300

RAINFALL. (McCONNELL.)

Inches of Depth.	Cubic Feet per Acre.	Imperial Gallons per Acre.	Tons per Acre.	Inches of Depth.	Cubic Feet per Acre.	Imperial Gallons per Acre.	Tons per Acre.
1	3,630	22,635	101.1	7	25,410	158,444	707.7
2	7,260	45,270	202.2	8	29,040	181,072	808.8
3	10,890	67,905	303.3	9	32,670	203,714	909.9
4	14,520	90,539	404.4	10	36,300	226,349	1011.0
5	18,150	113,174	505.5	11	39,930	248,984	1112.1
6	21,780	135,809	606.6	12	43,560	271,619	1213.2

TABLE SHOWING THE FORCE AND VELOCITY OF WIND. (WARING.)

Miles per Hour.	Feet per Minute.	Lbs. Pressure on 1 sq. ft.	Description.
1	88	.005	Barely observable.
2	176	.020	Just perceptible.
3	264	.045	
4	352	.080	Light breeze.
5	440	.125	Gentle, pleasant wind
6	528	.180	
8	704	.320	
10	880	.500	Brisk blow.
15	1320	1.125	
20	1760	2.000	Very brisk.
25	2200	3.125	
30	2640	4.500	High wind.
35	3080	6.125	
40	3520	8.000	Very high.
45	3960	10.125	
50	4400	12.500	Storm.
60	5280	18.000	Great storm.
80	7040	32.000	Hurricane.
100	8800	50.000	Tornado, uprooting trees, sweeping off buildings, etc.

NUMBER OF SQUARE FEET AND ACRES THAT A First-class Windmill can Irrigate One Inch in 8 Hours, Raising the Water 10, 15 or 25 Feet.

(A. R. WOLFF.)

Size of Windmill.	10 Feet.		15 Feet.		25 Feet.	
	Sq. Ft.	Acres	Sq. Ft.	Acres	Sq. Ft.	Acres
8½ ft. diam. of wheel..	11,736.34	.269	7,824.74	.180	4,744.74	.109
10 " " " " ..	37,161.74	.853	24,774.75	.569	14,767.83	.339
12 " " " " ..	66,765.16	1.533	44,509.85	1.022	26,134.57	.600
14 " " " " ..	85,982.05	1.974	57,321.11	1.316	34,757.03	.798
16 " " " " ..	120,106.14	2.757	80,070.76	1.838	49,742.00	1.142
18 " " " " ..	192,446.10	4.418	123,164 58	2.827	75,215.14	1.727
20 " " " " ..	238,395.08	5.473	158,930.31	3.649	96,211.50	2.209
25 " " " " ..	410,038.09	9.413	273,359.24	6.275	163,533 37	3.75
30 " " " " ..	831,686.24	19.093	561,197.56	12.883	331,752.96	7.616

TABLE SHOWING CAPACITY OF WINDMILLS.

(A. R. WOLFF.)

	Designation of Mill.	Velocity of Wind in Miles per hour.	Revolutions of Wheel.	Gallons of Water Raised per Minute to an Elevation of						Equivalent Actual Useful Horse-power Developed.	Average Number of Hours per Day During which this Result will be Obtained.
				25 ft.	50 ft.	75 ft.	100 ft.	150 ft.	200 ft.		
I	8½-ft. wheel	16	70 to 75	6.162	3.016	....	....	......	....	.04	8
II	10 " "	16	60 " 65	19.179	9.563	6.538	4.750	...	....	.12	8
III	12 " "	16	55 " 60	33.941	17.952	17.952	11.851	5.680	....	.21	8
IV	14 " "	16	50 " 55	45.139	22.569	15.304	11.246	7.807	4.[illegible]98	.28	8
V	16 " "	16	45 " 50	64.600	31.654	19.542	16.150	9.771	8.075	.41	8
VI	18 " "	16	40 " 45	97.682	52.165	32.513	24.421	17.485	12.[illegible]11	.61	8
VII	20 " "	16	35 " 40	124.950	63.750	40.800	31.248	19.[illegible]84	15.938	.78	8
VIII	25 " "	16	30 " 35	212.381	106.964	71.604	49.725	[illegible]7.349	26.741	1.34	8

TABLE SHOWING ECONOMY OF WINDMILLS.

(A. R. Wolff.)

	Designation of Mill.	Gallons of Water Raised 25 Feet per Hour.	Equivalent Actual Useful Horse-power Developed.	Average Number of Hours per Day During which this Quantity will be Raised.	Expense of Actual Useful Power Developed, in cents per hour.					Expense per Horse-power, in cents per hour.
					For Interest on First Cost (first cost including cost of wind-mill, pump, and tower) at 5% per annum.	For Repairs and Depreciation (5% of first cost per annum).	For Attendance.	For Oil.	Total	
I	8½-ft. wheel	370	.04	8	.25	.25	.06	.04	.60	15.0
II	10 " "	1,151	.12	8	.30	.30	.06	.04	.70	5.8
III	12 " "	2,036	.21	8	.36	.36	.06	.04	.82	3.9
IV	14 " "	2,708	.28	8	.75	.75	.06	.07	1.63	5.8
V	16 " "	3,876	.41	8	1.15	1.15	.06	.07	2.43	5.9
VI	18 " "	5,861	.61	8	1.35	1.35	.06	.07	2.83	4.6
VII	20 " "	7,497	.79	8	1.70	1.70	.06	.10	3.56	4.5
VIII	25 " "	12,743	1.34	8	2.05	2.05	.06	.10	4.26	3.2

NOMINAL HORSE-POWER REQUIRED FOR THE DISCHARGE OF GIVEN QUANTITIES OF WATER WITH LIFTS OF 10 AND 20 FEET. (SCOTT.)

Diameter of Pipe, Inches.	Gallons Discharged per Minute.	Nominal H.P. required for a 10-foot Lift.	Nominal H.P. required for a 20-foot Lift.
3	100	1	2
4	200	1½	3
5	350	2	4
6	500	2½	5
7	759	3	6
8	1000	4	8
10	1500	6	10
12	2300	8	14
14	2800	10	16
15	3300	12	20
18	6000	20	35

IRRIGATION. (Yearbook U. S. Dept. of Agriculture.)

A *water right* is the right or privilege of using water for irrigating purposes, either in a definite quantity or upon a prescribed area of land, such right or privilege being customarily acquired either by priority of use or by purchase. In many parts of the arid region a water right is an exceedingly valuable property. The average value of the water rights of the entire arid region, as determined by the census of 1890, was $26 per acre, and there are fruit-growing districts in California where water rights have been sold at as high as $1500 per miner's inch, or from $100 to $500 per acre, according to the amount used on any given area of land.

The *duty of water* is the extent of the service it will perform when used for irrigating purposes, that is, the number of acres a given quantity of water will adequately irrigate under ordinary circumstances. This is usually from 100 to 200 acres for each second-foot. Where water is abundant the duty has been known to be as low as 50 acres, and where very scarce as high as 500 acres, to the second-foot.

A *miner's inch* is theoretically such a quantity of water as will flow through an aperture 1 inch square in a board 2 inches thick under a head of water of 6 inches in one second of time, and it is equal to 0.194 gallon, or 0.0259337 cubic foot, per second, or to 11.64 gal., or 1.556024 cubic ft., per minute. The amount of water flowing through a given aperture in a given time varies, however, with the head of water over the opening, and also with the form of the opening. In Colorado the miner's inch legalized by statute equals 11.7 gal. per min. The California miner's inch, however, equals only 9 gal. per min., 100 Colorado inches being, accordingly, equal to 130 California inches. One hundred Colorado inches will cover an acre to a depth of 5.2 ft. in 24 hours; 100 California inches will cover the same area only to a depth of 4 ft. in the same time. Fifty California inches are, therefore, approximately equal to 1 second-foot, and 50 Colorado inches equal to about three tenths more.

An *acre-foot of water* is the amount required to cover an acre of ground to a depth of 1 foot. This is 43,560 cubic feet, or 325,851.45 gal. Its weight is 1213 tons 2113 pounds, at 2240 pounds to the ton.

The amount of water required to cover an acre of ground to a depth of 1 inch is 3630 cubic feet, or 27,154.29 gal. Its weight is 101 tons 362½ pounds, at 2240 pounds to the ton.

A *second-foot* is the most satisfactory because the most definite unit of measurement for flowing water. It is used by the U. S. Government in the gauging of rivers and streams, and is rapidly superseding the miner's inch in the measurement of water for irrigation. It is the quantity represented by a stream 1 foot wide and 1 foot deep flowing at the average rate of 1 foot per second. In other words, it is 1 cub. ft. per second, 60 cub. ft. per min., 3600 cub. ft. per hour, etc. A stream flowing continuously at the average rate of 1 second-foot would carry in one day of 24 hours 86,400 cub. ft., or 646,316.9 gal., sufficient to cover $1\frac{116}{121}$ acres to a depth of 1 ft. Flowing continuously for one year of 365 days, such a stream would carry 31,536,000 cub.

ft., or 235,905,678.7 gal., sufficient to cover $723\frac{117}{121}$ acres to a depth of 1 ft.

The *sub-humid region* is the strip of country running north and south between the arid region, where irrigation is absolutely necessary to the successful prosecution of agriculture, and those portions of the United States in which the rainfall is usually sufficient for agricultural purposes. It includes portions of North Dakota, South Dakota, Nebraska, Kansas, and Texas, and may be described as a region where irrigation is not always necessary, but where agricultural operations cannot, with any assurance of success, be undertaken without it.

The average *value of the irrigated land in farms* in the United States was ascertained by the census of 1890 to be $83.28 per acre, and that of the non-irrigated land in farms $20.95 per acre.

The average annual value of the agricultural products of the irrigated land was ascertained to be $14.89 per acre irrigated, and that of those of the non-irrigated land $6.80 for each acre improved.

The average first cost of the irrigated land, including purchase money, water rights, etc., was ascertained to have been $8.15 per acre, and the average annual cost of the water supply $1.07 per acre.

The total value of the irrigated farms of the United States, as reported by the farmers themselves, was, in round figures, $296,850,000, an increase of $219,360,000, or 283 per cent, upon their cost, including land, water right, fences, and preparation for cultivation.

The total value of the productive irrigating systems was found to be $94,412,000, an increase of $64,801,000, or 219 per cent, upon their cost.

CARRYING CAPACITY OF PIPES, GALLONS PER MINUTE. (WILCOX.)

Size of Pipe.	1-inch Fall per 100 ft.	2-inch Fall per 100 ft.	3-inch Fall per 100 ft.	6-inch Fall per 100 ft.	9-inch Fall per 100 ft.	1-foot Fall per 100 ft.	2-foot Fall per 100 ft.	3-foot Fall per 100 ft.
3 inch.	13	19	23	32	40	46	64	79
4 "	27	38	47	66	81	93	131	163
6 "	75	105	129	183	224	258	364	450
8 "	153	216	265	375	460	527	750	923
9 "	205	290	355	503	617	712	1,006	1,240
10 "	267	378	463	655	803	926	1,310	1,613
12 "	422	596	730	1,033	1,273	1,468	2,076	2,554
15 "	740	1,021	1,282	1,818	2,224	2,464	3,617	4,467
18 "	1,168	1,651	2,022	2,860	3,508	4,045	5,704	7,047
24 "	2,396	3,387	4,155	5,874	7,202	8,303	11,744	14,466
30 "	4,187	5,920	7,252	10,557	12,580	14,504	20,516	25,277

FLOW OF WATER THROUGH STRAIGHT PIPES

Flowing Full, in Gallons per Minute.

(COLLET.)

Diam in Inches.	Head of Water Divided by Length of Pipe.								
	1/100	1/50	1/25	1/10	2/10	3/10	5/10	8/10	1/1
1/16	.....	......	.....	.024	.036	.046	.06	.077	.086
1/8	.....	....	...	.056	.075	.089	.124	.158	.18
3/16	......	.....	......	.14	.21	.26	.34	.44	.50
1/4	...	...	....	.31	.44	.52	72	.92	1.04
3/8	.22	.33	.5	.83	1.2	1.5	2.0	2.6	2.9
1/2	.46	.70	1.0	1.8	2.5	3.1	4.1	5.3	6 0
3/4	1.33	1.98	2 9	4 9	7.1	8.9	11.7	15	16.9
1	2.79	4.15	6.1	10	14.8	18.4	24	31	35
1¼	4.96	7.36	10.8	18	26	32	42	54	61
1½	7.93	11.75	17.2	28	41	51	67	86	97
1¾	11.7	17.4	25.5	42	61	76	100	128	144
2	16.6	24	36	59	86	106	140	179	202
2½	29	43	63	104	151	188	246	315	354
3	46	69	101	166	240	298	390	500	562
4	98	144	210	344	498	617	808	1033	1162
5	173	254	370	606	876	1085	1419	1815	2040
6	227	404	589	959	1389	1720	2248	2876	3230

If the diameter be doubled, nearly 5.8 times the quantity can be passed.

POWER REQUIRED TO RAISE WATER FROM DEEP WELLS BY PUMPING. (Appleby.)

Gallons of water raised per hour	200	350	500	650	800	1000
Height of lift for one man, in feet	90	51	36	28	22	18
" " " " " donkey, in feet	180	102	72	56	45	36
" " " " " horse, "	630	357	252	196	154	126
" " " " " H.P. steam, in feet	990	561	396	308	242	198

APPROXIMATE COST OF DIFFERENT KINDS OF PIPE USED FOR IRRIGATION. (Wilcox.)

Diameter in Inches.	Sheet Iron or Steel Pipe, No. 16 B.W.G.	Sheet Iron or Steel Pipe, No. 14 B.W.G.	Sheet Iron or Steel Pipe, No. 12 B.W.G.	Cast-iron Pipe, Class B, or Medium.	Vitrified Clay Pipe.	Wooden Pipe.	Cement Pipe.
6	$0.32	$0.41	$0.52	$0.72½	$0.16½	....	$0.12
8	.42	.51	.62	1.04½	.22	....	.20
10	.53	.60	.85	1.42	.33	....	.26
12	.63	.68	.98	1.84	.41½	....	.32
14	.69	.75	1.17	2.30	.55	$0.74	.38
16	.82	.93	1.25	2.83	.68½	.94	.45
18	.91	1.00	1.43	3.37	.82½	1.08	.53
20	1.00	1.14	1.63	3.97	.96½	1.22	.60
22	1.05	1.30	1.85	4.62	1.21	1.32	.68
24	....	1.46	2.00	5.33	1.37½	1.40	.80

AVERAGE COST PER MILE OF CONSTRUCTING IRRIGATING CANALS AND DITCHES.

(Eleventh U. S. Census.)

States and Territories.	Under 5 Feet in Width.	5 to 10 Feet in Width.	10 Feet and Over in Width.
General average	$481	$1,628	$5,603
Arizona	$471	$1,674	$5,274
California	885	5,957	15,511
Colorado	380	1,131	5,258
Idaho	205	810	1,320
Montana	325	800	2,300
Nevada	200	1,150	......
New Mexico	310	581	6,666
Oregon	260	1,060	1,300
Utah	493	1,025	3,072
Washington	285	1,236	2,571
Wyoming	......	837	3,884
Sub-humid region	303	447	1,884

CAPACITIES OF WINDMILLS AND PUMPS.

(IRRIGATION AGE.)

Sizes of Irrigation Mills and Pumps best Adapted for each other to Work Successfully under Ordinary Conditions.

Size of Mill.	Diam. of Pump-cylinder.	Depth of Well.	Length of Mill Stroke.	Amount of Water each Stroke.	Amount of Water per Hour.	Amount of Water in 24 Hours.	Amount of Land Covered.*	Size of Reservoir.† Intr. Diam.
Ft.	In.	Ft. and under.	In.	Gals.	Gals.	Gals.	Acres.	Feet.
				10-foot Mills.				
10	8	30	10	1¾	3,660	87,840	....	....
10	6	50	10	1¼	2,580	61,920	....	....
10	4	75	10	⅝	1,320	31,680	....	....
				12-foot Mills.				
12	10	30	12	4⅙	7,500	180,000	103	90×75
12	8	50	12	3½	6,300	151,200	86	90×60
12	6	75	12	1½	2,700	64,800	37	60×40
12	4	125	12	¾	1,320	31,680	18	50×30
				14-foot Mills.				
14	12	30	14	6⅓	10,620	254,880	146	125×80
14	10	50	14	4⅓	7,260	174,240	100	90×75
14	8	75	14	2¾	4,620	100,880	63	75×50
14	6	125	14	1¾	2,940	71,560	40	65×40
14	4	175	14	1	1,680	40,320	23	50×30

* Amount of land that can be covered 1 ft. deep with windmills working at the rate of 15 hours per day for 300 days in the year. Acres covered 1 ft. deep.

† Capable of holding water for 24 hours' continuous pumping. These sizes should have 4 ft. depth of water, height of bank 5 ft., width of base 16 ft., 2 ft. of water below discharge-pipe not included. These reservoirs to connect with additional reservoir by overflow-pipe in order to utilize full capacity of mills and pumps. Overflow-reservoir should be of 1- and 2-acre capacity, 8 ft. deep, banks 9 ft. high, base of bank 45 ft., acre size 209 ft. on each side, corners rounded; 2-acre size 209 × 418 ft.

THE CALIFORNIA WEIR TABLE. (Wilcox.)

Depth.	Miner's Inches.	Depth.	Miner's Inches.	Depth.	Miner's Inches.	Depth.	Miner's Inches.
⅛	.01	3⅞	2.56	7⅝	7.04	12¾	15.27
¼	.04	4	2.69	7¾	7.22	13	15.72
⅜	.07	4⅛	2.81	7⅞	7.40	13¼	16.18
½	.12	4¼	2.93	8	7.58	13½	16.64
⅝	.17	4⅜	3.07	8⅛	7.76	13¾	17.10
¾	.22	4½	3.19	8¼	7.93	14	17.57
⅞	.27	4⅝	3.33	8⅜	8.12	14¼	18.04
1	.33	4¾	3.47	8½	8.30	14½	18.52
1⅛	.39	4⅞	3.61	8⅝	8.48	14¾	19.00
1¼	.46	5	3.75	8¾	8.67	15	19.48
1⅜	.54	5⅛	3.89	8⅞	8.86	15¼	19.98
1½	.62	5¼	4.03	9	9.05	15½	20.47
1⅝	.69	5⅜	4.18	9⅛	9.23	15¾	20.97
1¾	.77	5½	4.32	9¼	9.42	16	21.47
1⅞	.86	5⅝	4.47	9⅜	9.62	16½	22.47
2	.95	5¾	4.62	9½	9.81	17	23.50
2⅛	1.04	5⅞	4.77	9⅝	10.00	17½	24.54
2¼	1.13	6	4.92	9¾	10.19	18	25.58
2⅜	1.22	6⅛	5.08	9⅞	10.39	18½	26.65
2½	1.32	6¼	5.24	10	10.59	19	27.74
2⅝	1.42	6⅜	5.39	10¼	10.99	19½	28.83
2¾	1.52	6½	5.54	10½	11.30	20	29.95
2⅞	1.63	6⅝	5.71	10¾	11.80	20½	31.07
3	1.74	6¾	5.87	11	12.22	21	32.21
3⅛	1.86	6⅞	6.04	11¼	12.65	21½	33.36
3¼	1.97	7	6.20	11½	13.06	22	34.52
3⅜	2.08	7⅛	6.37	11¾	13.50	22½	35.70
3½	2.19	7¼	6.53	12	13.94	23	36.90
3⅝	2.31	7⅜	6.70	12¼	14.38	23½	38.10
3¾	2.43	7½	6.87	12½	14.82	24	39.32

CAPACITY OF CISTERNS AND TANKS, in Gallons, for Each Twelve Inches in Depth.

(A. R. Wolff.)

Diameter in Feet.	Gallons.	Diameter in Feet.	Gallons.	Diameter in Feet.	Gallons.
1.0	5.87	6.5	248.23	11.0	710.90
2.0	23.50	7.0	287.88	11.0	777.05
2.5	36.72	7.5	330.48	12.0	846.03
3.0	52.88	8.0	376.00	13.0	992.91
3.5	71.97	8.5	424.48	14.0	1151.54
4.0	94.00	9.0	475.89	15.0	1321.92
4.5	118.87	9.5	530.24	20.0	2350.08
5.0	146.88	10.0	587.52	25.0	3672.00
5.5	177.72	10.5	647.74	30.0	5287.68
6.0	211.51				

Capacity of Cisterns in Barrels, Per Foot in Depth.
(HALL.)

Square Cistern.	Barrels.	Circular Cistern.	Barrels.
5 feet by 5 feet holds........	5.92	5 feet in diameter holds.....	4.66
6 " " 6 " "	8.54	6 " " " "	8.54
7 " " 7 " "	11.63	7 " " " "	11.63
8 " " 8 " "	15.19	8 " " " "	15.19
9 " " 9 " "	19.39	9 " " " "	19.39
10 " " 10 " "	23.74	10 " " " "	23.74

ROAD-MAKING. (CAMPBELL.)

Drainage.—Perfect drainage, first of the foundation of the roadbed, secondly of the road surface, are the points in road-making on which too much stress cannot be laid.

The first is accomplished by underdrainage, tile drains being laid at a depth of three or more feet below the surface on each side of the roadbed at the foot of the grade and parallel to it. Care should be taken to fit and settle the tile in the trench so that, when refilling with earth, they will not be displaced. As a rule 2½- to 4-in. tile will be sufficient. The joints should be close, and the grade a true line. Loose joints and an uneven grade allow silt to pass into the tile and remain there, destroying the drain.

Surface drainage is accomplished by open drains on each side of the grade, having sufficient capacity to drain, both the roadbed and the land adjoining. With open drains and with tile drains make and maintain a free outlet to the nearest watercourse. A drain without an outlet is useless.

Crowning the Road.—The graded portion of the road should be wide enough to accommodate the travel upon it, and not greater, the slope being uniform, not heaped in the centre. The crown should be well above the overflow of storm water, and should have a grade sufficient to shed water readily to the open ditches on either side. Do not round it up so as to make the grade steep and dangerous, under the mistaken impression that better drainage will thereby be secured. Nor should it be so low as to allow water to stand upon it in depressions. Under ordinary circumstances one inch or one inch and a half to the foot is

a proper grade; that is, a roadbed twenty-six feet wide should be from thirteen to twenty inches higher at the center than at the side.

Quality of Gravel.—The gravel should preferably be sharp, clean, and of uniform size. Pit gravel usually contains too much earthy matter, and where the latter is in excess, the gravel, as a road-making material, is useless. Lake gravel is apt to be rounded, water-worn, and lacking in the necessary earthy matter to make a solid and compact surface, but is generally a better road material than pit gravel. A coating of pit gravel with a surfacing of creek gravel is a good combination. All large stones should be removed, as they will work to the surface, and will then roll loosely or form rough protuberances.

Placing the Gravel.—The gravel should be spread evenly over the surface of the sub-grade to a depth of six or eight inches, and to the required width, then rolled with a heavy roller. Rolling should be performed in showery weather, as it is impossible to consolidate dry earth or gravel. The heavier the roller the better will be the results, but if a heavy roller cannot be obtained, a light roller is much better than none. The roller should be passed over the surface until the gravel or earth is so compact as not to be displaced and rutted by the wheels of a wagon passing over it with an ordinary load. The surface must be maintained smooth and hard, to shed water and resist wear. Every municipality should have a roller, but whether one can be obtained or not the gravel should not be left in a heap just as it falls from the wagon. Spread it evenly.

Repairs.—Gravel roads already constructed will need repair. By the use of road machinery, scrape the surface and cut off the corners, which will have formed at the foot of the grade by the washing down of dusty material from the crown of the road. Loosen the surface, particularly that part of the traveled portion and where the road is rutted, with picks, or, if possible, with road machinery ; then apply a coating of gravel, and roll thoroughly. It is of more importance, however, to see that the drains are not obstructed in their course and that their outlets are free and open.*

* See Farmers' Bulletin, No. 95, "Good Roads for Farmers," Washington, 1899.

IMPORTANCE OF GOOD ROADS.

It is estimated that it costs a farmer more to haul a bushel of wheat than it does a railroad to haul a ton; that our poor roads cost the farmer at least $15.00 a year for every horse, and that good earth roads would save more than half the cost of hauling, and good permanent roads more than three quarters of it. (GILMORE.)

Force Required to Draw a Load on Different Kinds of Roads.

	Force Required to Draw a Gross Load of 2240 Pounds.	Steepest Grade (rise per 100 ft.) on which Vehicle will not Roll Back.	Draught on a Level Compared with that on Different Grades. Rise in feet per 100 feet.					
			0	3	6	9	12	15
	Pounds	Feet						
Earth road.......	200	8.9	1	1.3	1.7	2.0	2.3	2.7
Gravel "	143½	6.4	1	1.5	1.9	2.4	2.9	3.3
Macadam road...	65	2.9	1	2.0	3.1	4.1	5.1	6.1
Telford " ...	46	2.0	1	2.5	3.9	5.4	6.8	8.2
Plank " ...	41	1.8	1	2.6	4.3	5.9	7.5	9.1
Stone trackway..	12½	.5	1	6.4	11.7	17.1	22.3	27.5

TRACTIVE FORCE REQUIRED FOR CARRIAGES of one ton, on a level road. (McCONNELL.)

Description of Road.	Force of Traction per Ton.
1. On rails	8 lbs.
2. Well-made pavement..........................	33 "
3. Macadamized road	44 to 67 "
4. Turnpike, hard and dry	68 "
5. " dirty....................................	88 "
6. Hard compact loam............................	119 "
7. Gravel...	150 "
8. Sandy and gravelly	210 "
9. Ordinary by-road................................	237 "
10. Turnpike, newly-gravelled	320 "
11. Loose sandy road	457 "

A horse produces his greatest mechanical effect in drawing a load 2½ miles per hour with a tractive force of 150 lbs.

FRACTION OF THE WEIGHT OF A VEHICLE AND LOAD REQUIRED TO MOVE SAME ON A LEVEL ROAD. (MORIN.)

Character of the Road.	Character of the Vehicle. 2-wheeled Carts.	Trucks, 4-wheeled, 3 and 4-horse.	4-horse Stage-coaches, on Springs.		2-horse Carriages, Body on Springs.	
Firm soil, covered with gravel 4 to 6 inches deep	$\frac{1}{12}$	$\frac{1}{9}$	$\frac{1}{8}$		$\frac{1}{8}$	
Firm embankment, covered with gravel 1¼ to 1½ inch. deep.	$\frac{1}{16}$	$\frac{1}{11}$	$\frac{1}{10}$		$\frac{1}{10}$	
Earth embankment, in very good condition..	$\frac{1}{41}$	$\frac{1}{29}$	$\frac{1}{26}$		$\frac{1}{26}$	
Bridge flooring of thick oak plank	$\frac{1}{70}$	$\frac{1}{48}$	$\frac{1}{14}$		$\frac{1}{42}$	
			Walk	Trot.	Walk.	Trot.
Broken-stone Road: In very good condition, very dry, compact and even .	$\frac{1}{75}$	$\frac{1}{54}$	$\frac{1}{48}$	$\frac{1}{41}$	$\frac{1}{49}$	$\frac{1}{42}$
A little moist or a little dusty..	$\frac{1}{53}$	$\frac{1}{38}$	$\frac{1}{34}$	$\frac{1}{27}$	$\frac{1}{34}$	$\frac{1}{27}$
Firm, but with ruts and mud.	$\frac{1}{33}$	$\frac{1}{24}$	$\frac{1}{21}$	$\frac{1}{18}$	$\frac{1}{22}$	$\frac{1}{19}$
Very bad, ruts 4 to 4½ inches deep, thick mud....	$\frac{1}{19}$	$\frac{1}{14}$	$\frac{1}{12}$	$\frac{1}{10}$	$\frac{1}{12}$	$\frac{1}{10}$
Good pavement, dry..	$\frac{1}{90}$	$\frac{1}{68}$	$\frac{1}{57}$	$\frac{1}{38}$	$\frac{1}{59}$	$\frac{1}{39}$
" " covered with mud	$\frac{1}{69}$	$\frac{1}{50}$	$\frac{1}{44}$	$\frac{1}{33}$	$\frac{1}{46}$	$\frac{1}{34}$

TRACTIVE POWER OF HORSES AT DIFFERENT SPEED. (TRAUTWINE.)

The average traction of a horse on a level and actually pulling for ten hours in the day may be assumed as follows:

Miles per hour.	Lbs. Traction.	Miles per hour.	Lbs. Traction.
¾	333.33	2¼	111.11
1	250	2½	100
1¼	200	2¾	90.91
1½	166.66	3	83.33
1¾	142.86	3½	71.43
2	125	4	62.50

If the horse works for a smaller number of hours, his traction may increase as the hours diminish, down to about 5 hours per day and for speeds of about from 1½ to 3 miles per hour.

EFFECT OF INCLINATION ON TRACTIVE FORCE.

(U. S. Department of Agriculture.)

Rate of Inclination.	Angle with the Level.	Tractive Force, Pounds.	Equivalent Length of Level Road in Miles.
Level.	0° 00′ 00″	38	1.00
1 in 500	0 6 53	42	1.10
1 in 100	0 34 23	58	1.52
1 in 80	0 42 58	63	1.66
1 in 60	0 57 18	71	1 87
1 in 50	1 08 16	78	2.05
1 in 40	1 25 57	88	2.30
1 in 30	1 54 37	104	2.73
1 in 25	2 17 26	118	3.10
1 in 20	2 51 21	138	3.63
1 in 15	3 48 51	171	4.50
1 in 10	5 42 58	238	6.26

The table gives the tractive force necessary to draw 1 ton over the best macadam road of various grades, and the equivalent length of each mile of grade in miles of level road.

The effect of the inclination can be calculated from the following formula:

$$R = F + aW,$$

where F = force required to draw the load on the level, a = the grade, expressed by a fraction, W = the weight of the load in pounds, R = force required to draw the load up the incline in question.

According to Gillespie, if a horse can pull on a level 1000 pounds, on a rise of

1 *foot in*		1 *foot in*	
100 feet he draws	900 lbs.	25 feet he draws	540 lbs.
50 " " "	810 "	24 " " "	500 "
44 " " "	750 "	20 " " "	400 "
40 " " "	720 "	10 " " "	250 "
30 " " "	640 "		

EFFECTS OF SURFACE ON TRACTIVE FORCE.

(Various Authorities, compiled by Herring.)

Description of Road.	Tractive Force, Lbs.	Description of Road.	Tractive Force, Lbs.
Loose sand	448	Very hard and smooth macadam	46
Loose gravel (deep)	320	Best macadam	52 to 32
Loose gravel (4 inches)	222	Cobblestone, ordinary	140
Common gravel road	147	Cobblestone, good	75
Good gravel	88	Belgian block	56 to 26
Hard-rolled gravel	75	Belgian block in Paris	54 to 34
Ordinary dirt road	224	Belgian block, good	34½
Hard clay	112	Stone block, ordinary	90
Hard, dry dirt road	89	Stone block, good	45
Macadam, little used	140 to 97	Stone block, London	36
Macadam, bad	160	Asphalt	17
Macadam, poor	112	Granite tramway	12½ to 13½
Macadam, common	64	Iron railway	8 to 11½
Good macadam, wet	75 to 42		
Best French macadam	45		

The velocity is in all cases taken at 3 miles per hour.

COST OF HAULING FARM PRODUCE IN THE UNITED STATES.

	Average Length of Haul.	Average Weight of Load for two Horses.	Average Cost per Ton per Mile.	Total Cost per Ton for whole Length of Haul.
	Miles.	Lbs.	Cents.	
Eastern States	5.9	2216	32	$1.89
Northern States	6.9	....	27	1.86
Middle-Southern States	8.8*	....	31	2.72
Cotton States	12.6	1397	25	3.05
Prairie States	8.8	2409	22	1.94
Pacific Coast and Mountain States	23.3	2197	22	5.12
Averages for the United States	12.1	2002	25	$3.02

* Middle States.

The total weight of farm products in 1895 was estimated at 219,824,227 tons; if the forest products hauled over the public roads be added to this, we get 313,349,227 tons, which at $3.02 per ton, makes a total for the annual cost of

hauling on the public roads of $946,414,665. Nearly, if not quite, two-thirds of this vast expense may be saved by road improvement, and this at a total cost not exceeding the losses of 3, or at most 4, years by bad roads (Circ. 19, Office of Road Inquiry, U. S. Dept. Agr.).

TRANSPORTATION ON THE FARM. (U. S. Dept. Agr.)

An ordinary wagon drawn by two horses will carry at each load 1 ton to 1½ tons of hay, grain, manure, etc , over a good road; with four horses, 3–4 tons. According to distance, the number of loads in a day should be as follows:

Number of Loads Hauled per Day.

Distance.	No. of Loads with Horses.	Oxen.	Distance.	No. of Loads with Horses.	Oxen.
Eighth mile.. ...	16–18	14–16	Half mile..............	10–14	8–12
Quarter mile	12–16	10–14	Mile to mile and a half.	6–9	5–7

LABOR ONE HORSE IS ABLE TO PERFORM at different rates of speed on canals, railroads, and turnpikes. (Drawing force, 83⅓ lbs.) (WARING.)

Speed per Hour, miles.	Duration of Day's Work, hours.	Useful Effect for 1 Day, drawn 1 mile. On a Canal, tons.	On a Railroad, tons.	On a Turnpike, tons.
2½	11½	520	115	14
3	8	243	92	12
3½	6	154	82	10
4	4½	102	72	9
5	2 9/10	52	57	7.3
6	2	30	48	6
7	1½	19	41	5
8	1⅛	12.8	36	4.5
9	9/10	9	32	4
10	¾	6.5	28.8	3.6

PERFORMANCE OF ONE TEAM AND PLOUGH IN A DAY, IN ACRES AND TENTHS. (WARING.)

Width of furrows in inches.	Acres.	Width of furrows in inches.	Acres.	Width of furrows in feet.	Acres.	Width of furrows in feet.	Acres.
5	1.0	12	2.4	2	4.8	5½	13.2
6	1.2	14	2.8	2½	6.0	6	14.4
7	1.4	16	3.2	3	7.2	6½	15.6
8	1.6	18	3.6	3½	8.4	7	16.8
9	1.3	20	4.0	4	9.6	7½	18.0
10	2.0	22	4.4	4½	10.8	8	19.2
11	2.2			5	12.0		

THE EFFECT OF WIDE WAGON-TIRES.

The effect of wide and narrow tires for wagons is well illustrated by the following results of carefully conducted experiments by the Studebaker Wagon Co., South Bend, Ind. In the trials given in the second column 1½-inch tires had been substituted for 4-inch tires. (Agr. of Pa., 1894; see also Mich. Exp. Sta., Bull. 165; Mo. Exp. Sta., Bull. 13, and Utah Exp. Sta., Bull. 4.)

	Width of Tires.	
	4 inches.	1½ inches.
	lbs.	lbs.
Weight of wagon and load	4345	4235
Draft to start load on block pavement	350	300
Draft to move load at a dead pull on block pavement	100	75
Draft to start load on good hard, sandy road	700	725
Draft to move load at a dead pull on good hard, sandy road	275	300
Draft to start load on good level gravel road	600	650
Draft to move load at a dead pull on good level gravel road	175	175
Draft to start load on muddy road	800	900
Draft to move load at a dead pull on muddy road	550	500

AVERAGE QUANTITY OF STONE REQUIRED PER YEAR TO KEEP 10 FEET OF ROAD, WIDTH = 20 FEET, IN REPAIR. (Herschel.)

	Cub. ft.	Cub. yds.
1. Good material and heavy travel	15–20	= .55– .74
2. Good material and medium amount of travel	10–15	= .37– .55
3. Good material and light travel	5–10	= .18– .37
4. Medium material and heavy travel	20–25	= .74– .92
5. Medium material and medium amount of travel	15–20	= .55– .74
6. Medium material and light travel	10–15	= .37– .55
7. Third-rate material and heavy travel	25–30	= .92–1.10
8. Third-rate material and medium amount of travel	20–25	= .74– .92
9. Third-rate material and light travel	15–20	= .55– .74

INTERIOR DIMENSIONS OF FARM BUILDINGS.

(McConnell.)

	Length.	Breadth.	Height.
	ft.	ft.	ft.
Barn	40	20	20
" (straw)	60	20	20
Cattle feeding-boxes, double	10	20	8
" " " single	10	10	8
Cattle-sheds, for each animal	5	15	8
Cart-sheds, etc., each arch	8	20	10
Cow-stable, for each cow, double	4	30	10
" " " " " single	4	20	10
Dairy	20	20	10
Fold-yards, for each animal	5	30	6
Granary	30	20	8
Hospital	18	18	9
Manure-house	18	18	8
Pigsties, for each 3 animals	6	10	8
Poultry-house	18	18	9
Root-house	20	20	10
Stable, for each horse	6.5	18	10
Workshop	18	18	9
General dimensions of other apartments	....	18	9

6½ ft. allowed to the length of the stable for each horse in it and 7 or 8 ft. for every pair of cows in cow-stable. Horses must each have 1200 cu. ft. of space, and cattle 800 cu. ft., where stalled in stables. Cattle-boxes to be sunk 2 ft. below surface and raised by a dwarf wall 1 ft. above. Cattle-folds and sheds should have a length of 5 ft. for every animal they are intended to contain; when covered, 150 sq. ft. allowed to every head. The pigsties have small open areas attached to each.

RECIPE FOR WHITEWASH.

Slake half a bushel of unslaked lime with boiling water, cover during the process to keep in steam, strain the liquid through a fine sieve or strainer, and add to it a peck of salt, previously dissolved in warm water, three pounds of ground rice boiled to a thin paste and stirred in while hot, half a pound of Spanish whiting, and one pound of clear glue, previously dissolved by soaking in cold water and then hanging over a slow fire in a small pot hung in a larger

one filled with water. Add five gallons of hot water to the mixture, stir well, and let it stand a few days, covered from dirt. It should be applied hot, for which purpose it can be kept in a kettle or portable furnace. The east end of the White House in Washington is embellished by this whitewash. It is recommended by the government for whitewashing light-houses.

A pint of this wash mixture, if properly applied, will cover one square yard, and will be almost as serviceable as paint for wood, brick, or stone, and is much cheaper than the cheapest paint.

Coloring matter may be added as desired. For cream color add yellow ochre; pearl or lead, add lampblack or ivory-black; fawn, add proportionately four pounds of umber to one pound of Indian red and one pound of common lampblack; common stone color, add proportionately four pounds raw umber to two pounds lampblack.

TABLE OF CUT NAILS. (TRAUTWINE.)

	Name.	Length, Inches.	No. per Lb.	Name.	Length, Inches.	No. per Lb.
"Common" nails	2-penny	1	716	10-penny	3	66
	3- " fine	1⅛	626	12- "	3¼	50
	3- "	1¼	440	20- "	4	32
	4- "	1⅜	300	30- "	4½	19
	5- "	1¾	210	40- "	5	16
	6- "	2	163	50- "	5½	13
	7- "	2¼	123	60- "	6	10
	8- "	2½	93			
Finishing-nails...	4-penny	1½	470	10-penny	3	84
	5- "	1¾	330	12- "	3¼	65
	6- "	2	196	20- "	4	50
	8- "	2½	116			
Slating-nails.....	3-penny	1¼	280	5-penny	1¾	160
	4- "	1½	200	6- "	2	128
Fence-nails......	....	2	80	....	2¾	48
	....	2¼	66	....	3	40
	....	2½	60			
Cut spikes........	....	3	29	....	5½	8
	....	3½	21	....	6	7
	....	4	15	....	6½	6
	....	4½	13	....	7	5
	....	5	10	....	8	3½

XII. HUMAN FOODS.

COMPOSITION OF HUMAN FOOD MATERIALS.*

(ATWATER.)

Ordinary food materials, such as meat, fish, eggs, potatoes, wheat, etc., consist of—

Refuse.—As the bones of meat and fish, shells of shellfish, skin of potatoes, bran of wheat, etc.

Edible Portion.—As the flesh of meat and fish, the white and yolk of eggs, wheat flour, etc. The edible portion consists of *water* and *nutritive ingredients* or *nutrients.*

The principal kinds of nutritive ingredients are *protein, fats, carbohydrates,* and *mineral matters.*

The water, refuse, and salt of salted meat and fish are called non-nutrients. In comparing the values of different food materials for nourishment they are left out of account.

Classes of Nutrients.—The following are familiar examples of compounds of the four principal classes of nutrients.

PROTEIN.
- *Proteids.*
  - *Albuminoids,* e.g., albumen (white of eggs); casein (curd) of milk; myosin, the basis of muscle (lean meat); gluten of wheat, etc.
  - *Gelatinoids,* e.g., collagen of tendons; ossein of bones; which yield gelatin or glue, etc.
- Meats and fish contain very small quantities of so-called "extractives." They include kreatin and allied compounds, and are the chief ingredients of beef-tea and meat-extract. They contain nitrogen, and hence are commonly classed with protein.

Fats, e.g., fat of meat; fat (butter) of milk; olive-oil; oil of corn, wheat, etc.

Carbohydrates, e.g., sugar, starch, cellulose (woody fiber), etc.

Mineral matters, e.g., phosphate of lime, sodium chlorid (common salt), etc.

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* Extracts from "Foods, Nutritive Value and Cost" (Farmers' Bulletin No. 23), and "Food and Diet" (U. S. Dept. of Agriculture Year Book, 1894). See also Farmers' Bull. No. 142, and Circ. No. 46, Rev., Office of Exp. Stations.

The Fuel Value of Food.—Heat and muscular power are forms of force or energy. The energy is developed as the food is consumed in the body. It is measured in the laboratory by means of an apparatus called the calorimeter. The unit commonly used is the calorie, the amount of heat which would raise the temperature of a pound of water 4° F. Instead of this unit, some unit of mechanical energy may be used, e.g., the foot-ton, which represents the force required to raise 1 ton 1 foot. One calorie is equal to very nearly 1.53 foot-tons.

The following general estimate has been made for the average amount of potential energy in 1 pound of each of the classes of nutrients:

	Calories.
In 1 pound of protein	1,814
In 1 pound of fats	4,037
In 1 pound of carbohydrates	1,814

In other words, when we compare the nutrients in respect to their fuel values, their capacities for yielding heat and mechanical power, a pound of protein of lean meat or albumen of egg is just about equivalent to a pound of sugar or starch, and a little over two pounds of either would be required to equal a pound of the fat of meat or butter or the body fat.

Ways in which Food is Used in the Body.—Food supplies the wants of the body in several ways. It either—

Is used to form the tissues and fluids of the body;

Is used to repair the wastes of tissues;

Is stored in the body for future consumption;

Is consumed as fuel, its potential energy being transformed into heat or muscular energy, or other forms of energy required by the body; or,

In being consumed protects tissues or other food from consumption.

Uses of the Different Classes of Nutrients.—Protein forms tissue (muscle, tendon, etc., and fat) and serves as fuel.

Fats form fatty tissue (not muscle, etc.) and serve as fuel.

Carbohydrates are transformed into fat and serve as fuel.

All nutrients yield energy in form of heat and muscular strength.

In being themselves burned to yield energy the nutrients protect each other from being consumed. The protein and fats of body tissue are used like those of food. An important use of the carbohydrates and fats is to protect protein (muscle, etc.) from consumption.

Definition of Food and Food Economy.—The views thus presented lead to the following definitions: (1) Food is that which, taken into the body, builds tissues or yields energy; (2) the most healthful food is that which is best fitted to the wants of the user; (3) the cheapest food is that which furnishes the largest amount of nutriment at the least cost; (4) the best food is that which is both most healthful and cheapest.

We have, then, to consider the kinds and amounts of nutrients in different food materials, their digestibility, and the kinds and amounts needed for nourishment by people doing different kinds of work.

In general, the animal foods have the most of protein and fats, while the vegetable foods are rich in the carbohydrates, starch, and sugar. The lean meats and fish abound in protein. Cheese has so large a quantity of protein because it contains the casein of the milk. Among the vegetable foods, beans and peas have a high proportion of protein. The proportion in oatmeal is also large. In wheat it is moderate, and in corn meal it is rather small. The materials with the highest fuel value are those with the most fat, because the fuel value of the fat is, weight for weight, two and one-fourth times as great as that of either sugar, starch, or protein. Hence fat pork and butter lead the other materials in fuel value. The fat meats in general stand high in this respect. So also do the grains, flour, and meal, as they have large quantities of carbohydrates. Potatoes are quite low in the list in respect to fuel value as well as protein, principally because they are three-fourths water. For the same reason, milk, which is seven-eighths water, ranks low in respect to both protein and fuel value.

Dietaries and Dietary Standards.—As the outcome of a great deal of observation and experiment, nearly all in Europe, standards have been proposed for the amounts of nutrients and energy in the daily food required by different classes of people. Those of Prof. Voit, of Munich, Germany, are most commonly accepted by specialists in Europe. Voit's standard for a laboring man at moderately hard muscular work calls for about 0.25 pound of protein and quantities of carbohydrates and fats sufficient, with the protein, to yield 3050 calories of energy. Taking into account the more active life in the United States, and the fact that well nourished people of the working classes here eat more and do more work than in Europe, and in the belief that ample nourishment is necessary for doing the most and the best work, I have ventured to suggest a standard with 0.28 pound of protein and 3500 calories of energy for the man at moderate muscular work. (For list of dietary standards, see p. 203; also Farmers' Bull., No. 142, p. 35.)

Calculation of Daily Dietaries.—Due regard for health, strength, and purse requires that food shall supply enough protein to build tissue and enough fats and carbohydrates for fuel, and that it shall not be needlessly expensive.

On the basis of the standards for dietaries given on page 175, various combinations of food materials for daily dietaries may be made by calculations from the table, showing percentages of nutrients, etc., in food materials (p. 169). Thus if a dietary for a man at moderately hard muscular work is to be made up of round beefsteak, butter, potatoes, and bread, it may be calculated as follows:

		Protein.	Calories.
		Pounds.	
Round steak	1 pound contains	.18	855
Butter	1 pound contains	.01	3,615
Potatoes	1 pound contains	.019	325
Wheat bread	1 pound contains	.088	1,280
Round steak	13 ounces contain	.14	695
Butter	3 ounces contain	....	680
Potatoes	6 ounces contain	.02	320
Wheat bread	22 ounces contain	.12	1,760
	Total	.28	3,455
	Standard for man at moderate muscular work	.28	3,500

PERCENTAGES OF NUTRIENTS, WATER, AND REFUSE IN SPECIMENS OF FOOD MATERIALS.

(ATWATER.)

Food Materials.	Refuse (Bones, Skin, Shell, etc.).	Edible Portion.					
		Water.	Nutrients.				
			Total.	Protein.	Fat.	Carbo-hydrates.	Mineral Matters.
Animal Foods, as Purchased.	%	%	%	%	%	%	%
Beef: Neck	20.0	49.6	30.4	15 6	14.0	......	0.8
Shoulder	12.6	55.8	31.6	17.0	13.7	......	0.9
Chuck rib	14.6	49.5	35.9	15.0	20.1	......	0.8
Rib	21.0	38.2	40.8	12.2	27.9	......	0.7
Sirloin	19.5	48 3	32.2	15.0	16.4	......	0.8
Round steak	7.8	60.9	31.3	18.0	12.3	......	1.0
Side without kidney fat	19.2	44.3	36.5	13.9	21.8	......	0.8
Rump, corned	5.0	70.8	24.2	16.7	5.1	......	2.4
Flank, corned	12.1	43.7	44.2	12.4	29.2	......	2.6
Veal: Shoulder	17.9	56.7	25.4	16.6	7 9	......	0.9
Mutton: Shoulder	16.3	49.0	34.7	15.1	18.8	......	0.8
Leg	18.1	50.6	31.3	15.0	15.6	......	0.7
Loin	15.8	41.5	42.7	12.6	29.5	......	0.6
Side, without kidney fat	17.3	44.2	38.5	15.0	23 7	......	0.8
Pork: Shoulder roast, fresh	14 6	43.0	42.4	13.6	28.0	......	0.8
Ham, salted, smoked	11.4	36.8	51.8	14.8	34.6	......	2.4
Chicken	38 2	44.6	17 2	15.1	1.2	......	0.9
Turkey	32.4	44 7	22.9	16.1	5.9	......	0.9
Eggs, in shell	13.7	63.1	23.2	12.1	10 2	......	0.9
Fish, etc.: Flounder, whole	66.8	27.2	6.0	5.2	0.3	......	0.5
Bluefish, dressed	48.6	43.0	11.1	9.8	0.6	......	0.7
Codfish, dressed	29.9	58.5	11.6	10.6	0.2	......	0.8
Shad, whole	50.1	35.2	14.7	9.2	4.8	......	0.7
Mackerel, whole	44.8	40.4	15.0	10.0	4.3	......	0.7
Halibut, dressed	17.7	61.9	20.4	15.1	4.4	......	0.9
Salmon, whole	35.3	40.6	24.1	14.3	8.8	......	1.0
Salt codfish	42.1	40.5	17.6	16.0	0.4	......	1.2
Smoked herring	50.9	19.2	29 9	20.2	8.8	......	0.9
Salt mackerel	40.4	28.1	31.5	14.7	15.1	......	1.7
Canned salmon	4.9	59.3	35.8	19.3	15.3	......	1.2
Lobsters	62.1	31.0	6 9	5.5	0.7	0.1	0.6
Oysters	82.3	15.4	2.3	1.1	0.2	0.6	0.4
Animal Foods, Edible Portion.							
Beef: Neck	......	62.0	38.0	19.5	17.5	......	1.0
Shoulder	......	63.9	36.1	19.5	15.6	......	1.0
Chuck rib	......	58.0	42.0	17.6	23.5	......	0.9
Rib	......	48.1	51.9	15.4	35.6	......	0.9
Sirloin	......	60.0	40.0	18.5	20.5	......	1.0
Round	......	68 2	31.8	20.5	10.1	......	1.2
Side, without kidney fat	......	54.8	45.2	17.2	27 1	......	0.9
Rump, corned	......	58.1	41.9	13.3	26.6	......	2.0
Flank, "	......	49.8	50.2	14.2	33.0	......	3.0
Veal: Shoulder	......	68.8	31.2	20.2	9.8	......	1.2
Mutton: Shoulder	......	58.6	41.4	18.1	22.4	......	0.9
Leg	......	61.8	38.2	18.3	19.0	......	0.9
Loin	......	49.3	50.7	15.0	35.0	......	0.7

COMPOSITION OF FOOD MATERIALS.

Nutritive ingredients, refuse, and fuel value.

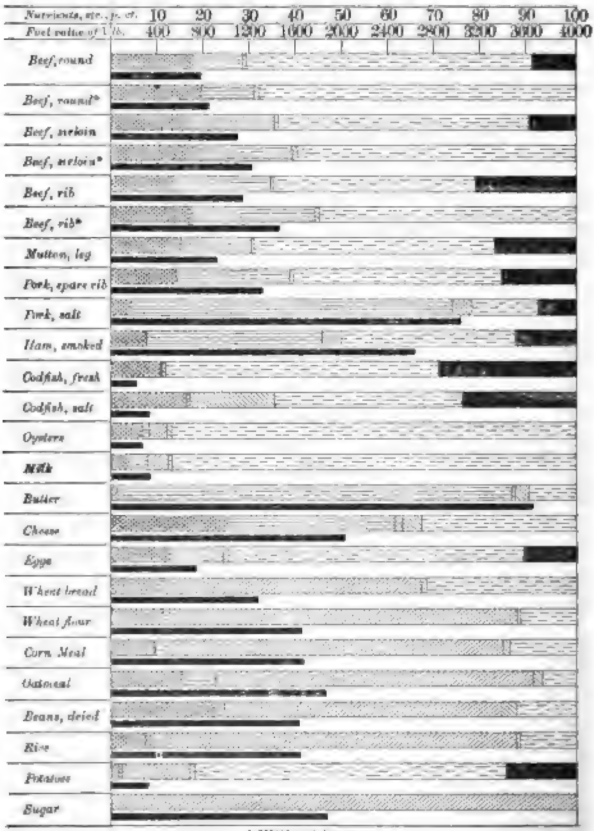
Nutrients. — *Protein*, *Fats.*, *Carbo-hydrates.*, *Mineral matters*

Non-nutrients. — *Water.*, *Refuse.*

Fuel value. — *Calories.*

Protein compounds, e. g., lean of meat, white of egg, casein (curd) of milk, and gluten of wheat, make muscle, blood, bone, etc.

Fats, e. g., fat of meat, butter, and oil, } serve as fuel to yield heat
Carbohydrates, e. g., starch and sugar, } and muscular power.



* Without bone.

PERCENTAGES OF NUTRIENTS, ETC., IN FOOD MATERIALS.—*Continued.*

Food Materials.	Edible Portion.					
	Water.	Nutrients.				
		Total.	Protein.	Fat.	Carbo-hydr.	Mineral Matters
Animal Foods, Edible Portion.	%	%	%	%	%	%
Mutton: Side, without kidney fat	53.5	46.5	16.9	28.7	.....	0.9
Pork: Shoulder roast, fresh	50.3	49.7	16.0	32.8	.....	0.9
Ham, salted, smoked	41.5	58.5	16.7	39.1	.....	2.7
Fat, salted	12.1	87.9	0.9	82.8	.....	4.2
Sausage: Pork	41.2	58.8	13.8	42.8	....	2.2
Bologna	62.4	37.6	18.8	15.8	.....	3.0
Chicken	72.2	27.8	24.4	2.0	.....	1.4
Turkey	66.2	33.8	23.9	8.7	.....	1.2
Eggs	73.8	26.2	14.9	10.5	.....	0.8
Milk	87.0	13.0	3.6	4.0	4.7	0.7
Butter	10.5	89.0	1.0	85.0	0.5	3.0
Oleomargarine	11.0	89.5	0.6	85.0	0.4	3.0
Cheese: Full-cream	30.2	69.8	28.3	35.5	1.8	4.2
Skim-milk	41.3	58.7	38.4	6.8	8.9	4.6
Fish: Flounder	84.2	15.8	13.8	0.7	.....	1.3
Haddock	81.7	18.3	16.8	0.3	.....	1.2
Codfish	82.6	17.4	15.8	0.4	....	1.2
Shad	70.6	29.4	18.6	9.5	.....	1.3
Mackerel	73.4	26.6	18.2	7.1	.....	1.3
Halibut	75.4	24.6	18.3	5.2	.....	1.1
Salmon	63.6	36.4	21.6	13.4	.....	1.4
Salt cod	53.6	.....	21.4	0.3	.....	1.6
Herring, salt	34.6	.....	36.4	15.8	....	1.5
Mackerel, salt	43.4	.....	17.3	26.4	.....	2.6
Oysters	87.1	12.9	6.0	1.2	3.7	2.0
Vegetable Foods.						
Wheat flour	12.5	87.5	11.0	1.1	74.9	0.5
Graham flour (wheat)	13.1	86.9	11.7	1.7	71.7	1.8
Rye flour	13.1	86.9	6.7	0.8	78.7	0.7
Buckwheat flour	14.6	85.4	6.9	1.4	76.1	1.0
Oatmeal	7.6	92.4	15.1	7.1	68.2	2.0
Cornmeal	15.0	85.0	9.2	3.8	70.6	1.4
Rice	12.4	87.6	7.4	0.4	79.4	0.4
Peas	12.3	87.7	26.7	1.7	56.4	2.9
Beans	12.6	87.4	23.1	2.0	59.2	3.1
Potatoes	78.9	21.1	2.1	0.1	17.9	1.0
Sweet potatoes	71.1	28.9	1.5	0.4	26.0	1.0
Turnips	89.4	10.6	1.2	0.2	8.2	1.0
Carrots	88.6	11.4	1.1	0.4	8.9	1.0
Onions	87.6	12.4	1.4	0.3	10.1	0.6
String beans	87.2	12.8	2.2	0.4	9.4	0.8
Green peas	78.1	21.9	4.4	0.6	16.0	0.9
Green corn	81.3	18.7	2.8	1.1	13.2	0.6
Tomatoes	96.0	4.0	0.8	0.4	2.5	0.3
Cabbage	91.9	8.1	2.1	0.3	5.5	1.1
Apples	83.2	16.8	0.2	0.4	15.9	0.3
Sugar, granulated	2.0	98.0	.....	....	97.8	0.2
Molasses	24.6	75.4	.....	...	73.1	2.3
White bread (wheat)	32.3	67.7	8.8	1.7	56.3	0.9
Boston crackers	8.3	91.7	10.7	9.9	68.7	2.4

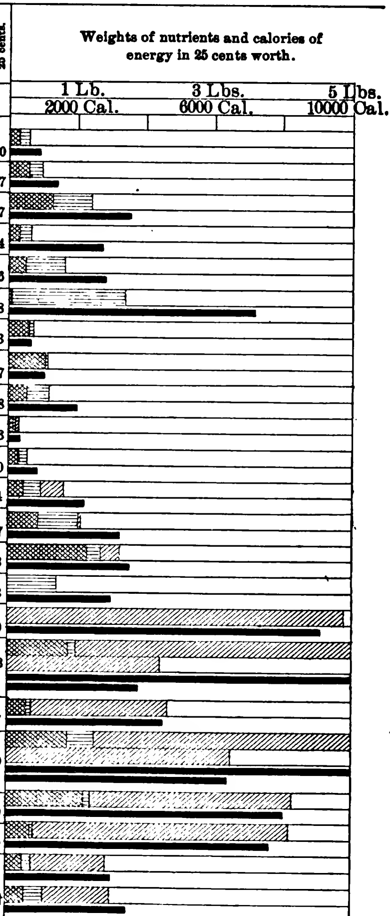
PECUNIARY ECONOMY OF FOOD.

Amounts of actually nutritive ingredients obtained in different food materials for 25 cents.

[Amount of nutrients in pounds. Fuel value in calories.]

Protein. Fats. Carbohydrates. Fuel value.

	Price per pound.	Food materials for 25 cents.
	Cts.	*Lbs.*
Beef, sirloin	25.0	1.00
Beef, round	15.0	1.67
Beef, neck	6.0	4.17
Mutton, leg	22.0	1.14
Ham, smoked	16.0	1.56
Salt pork, very fat	12.0	2.08
Codfish, fresh	8.0	3 13
Codfish, salt	7.0	3.57
Mackerel, salt	12.0	2.08
Oysters, 35 cents quart	18.0	1.43
Eggs, 25 cents dozen	14.7	1.70
Milk, 7 cents quart	3.5	7.14
Cheese, whole milk	15.0	1.67
Cheese, skim milk	8.0	3.13
Butter	30.0	0.83
Sugar	5.0	5.00
Wheat flour	3.0	8.33
Wheat bread	7.0	3.57
Corn meal	2.5	10.00
Beans	5.0	5.00
Potatoes	1.2	20.00
Standard for daily diet for man at moderate work.	*German.**	
	American.†	



*Voit †Atwater.

AMOUNTS OF NUTRIENTS FURNISHED FOR TWENTY-FIVE CENTS IN FOOD MATERIALS AT ORDINARY PRICES. (Atwater.)

Food Materials as Furnished.	Prices per Pound.	Twenty-five Cents will pay for					
		Total Food Materials.	Nutrients.				Calories of Potential Energy.
			Total.	Protein	Fats.	Carbo-hydr.	
	cts.	lbs.	lbs.	lbs.	lbs.	lbs.	cals.
Meats, etc.							
Beef: Neck	8	3.13	.95	.49	.44	......	2765
	6	4.17	1.27	.65	.58	......	3655
Chuck-ribs	16	1.56	.56	.23	.31	......	1735
	12	2.08	.75	.31	.42	......	2350
Ribs	22	1.14	.47	.14	.32	......	1610
	18	1.39	.57	.17	.39	......	1960
Shoulder	14	1.79	.57	.30	.25	......	1615
	10	2.50	.79	.43	.34	.....	2235
Sirloin	22	1.14	.37	.17	.19	......	1120
	18	1.39	.45	.21	.23	......	1360
Rump	18	1.39	.63	.19	.43	.....	2170
	15	1.67	.76	.23	.52	......	2620
Round, first cut	18	1.39	.44	.25	.17	......	1180
	15	1.67	.52	.30	.21	......	1445
Round, second cut	10	2.50	.52	.35	.15	.....	1285
	8	3.13	.65	.44	.18	......	1580
Flank, corned	15	1.67	.77	.21	.49	......	2460
	10	2.50	1.11	.31	.73	......	3655
Corned and canned	18	1.39	.66	.37	.24	......	1700
	14	1.79	.85	.48	.31	......	2200
Liver	8	3.13	.96	.63	.17	.11	2095
Mutton: Shoulder	20	1.25	.41	.18	.22	......	1265
	15	1.67	.58	.25	.31	......	1775
Leg	25	1.00	.31	.15	.16	.. ...	955
	20	1.25	.39	.19	.20	......	1195
Loin	25	1.00	.43	.13	.29	......	1465
	20	1.25	.53	.15	.37	......	1840
Pork: Rib roast	12	2.08	.88	.28	.58	......	2970
	16	2.50	1.06	.34	.70	......	5885
Smoked ham, whole	16	1.56	.86	.25	.58	......	2915
	12	2.08	1.08	.31	.72	......	3615
Salt fat pork	15	1.67	1.17	.02	1.38	......	5860
	12	2.08	1.03	.02	1.72	......	7295
Pork sausage	15	1.67	.98	.13	.72	......	3465
	12	2.08	1.22	.29	.89	......	4295
Poultry, etc.: Chicken	22	1.14	.32	.28	.02	......	605
	16	1.56	.45	.38	.03	......	835
Turkey	23	1.09	.37	.26	.09	......	865
	18	1.38	.47	.32	.12	......	1100
Fish, etc.							
Mackerel, whole	18	1.39	.22	.14	.06	. ....	515
	15	1.67	.25	.17	.07	......	610
	10	2.50	.37	.25	.11	....	930
Bluefish, dressed	15	1.67	.19	.16	.01	.... .	340
	10	2.50	.28	.25	.02	......	550
Cod, dressed	10	2.50	.28	.25	.01	.....	505
	8	3.13	.36	.33	.01	......	6[illegible]5
	6	4.17	.48	.44	.01	......	810

AMOUNTS OF NUTRIENTS FURNISHED FOR TWENTY-FIVE CENTS IN FOOD MATERIALS AT ORDINARY PRICES.—*Continued.*

Food Materials as Furnished.	Prices per Pound.	Twenty-five Cents will pay for: Total Food Materials.	Nutrients. Total.	Protein	Fats.	Carbo-hydr.	Calories of Potential Energy.
Fish, etc.	cts.	lbs.	lbs.	lbs.	lbs.	lbs.	cals.
Halibut steaks	20	1.25	.26	.19	.06	.....	605
	16	1.56	.32	.24	.07	......	740
Canned salmon	20	1.25	.46	.25	.20	......	1310
Oysters, 50 cts. per quart	25	1.00	.13	.06	.01	.04	230
" 35 " "	17.5	1.43	.18	.09	.02	.05	345
Lobster, whole	12	2.08	.14	.11	.01	......	345
	10	2.50	.17	.14	.02	......	415
" canned	20	1.25	.28	.23	.01	......	470
Eggs and Dairy Products.							
Eggs, 35 cts. per doz.	25	1.00	.23	.12	.10	......	645
" 25 " "	18.2	1.37	.32	.17	.14	......	910
" 15 " "	11	2.27	.53	.28	.23	......	1490
Milk, 8 cts. per quart.	4	6.25	.81	.23	.25	.29	2020
" 6 " "	3	8.33	1.08	.30	.33	.39	2675
" 4 " "	2	12.50	1.63	.40	.5[illegible]	.59	4065
Butter	35	.71	.64	.01	.60	......	2550
Cheese, full cream	25	1.00	.90	.01	.85	.01	3635
	18	1.38	.96	.40	.49	.02	3850
	12	2.08	1.45	.50	.72	.04	4210
Vegetable Foods.							
Potatoes, $1.00 per bushel	1.7	14.70	.31	.03	.01	.26	580
" .80 "	1.25	20.00	.42	.04	.02	.36	790
" .50 "	0.85	29.40	.62	.06	.03	.53	1225
Sweet potatoes.	5	5.00	.14	.00	.00	.13	240
	3	8.33	.24	.01	.00	.22	430
Beets	2	12.50	.14	.02	.00	.11	240
	1	25.00	.29	.04	.00	.22	485
Turnips	2	12.50	.13	.02	.00	.10	225
	1	25.00	.27	.03	.01	.21	490
Sugar	5	5.00	4.90	.00	.00	4.89	9095
Dried beans	6	4.17	3.64	.96	.09	2.47	6760
	5	5.00	4.37	1.15	.10	2.96	8065
	4	6.25	5.46	1.44	.13	3.70	11110
Maize "corn" meal	3	8.33	7.08	.77	.32	5.88	13720
	1	25.00	21.25	2.30	.95	17.65	41115
Oatmeal	5	5.00	4.61	.74	.36	3.42	9255
Wheat flour	4	6.25	5.47	.69	.07	4.68	10285
	3.5	7.14	6.25	.79	.08	5.35	11755
	3	8.33	7.29	.92	.09	6.24	13695
Wheat bread	7	3.57	2.42	.31	.06	2.01	4570
	5	5.00	3.38	.44	.09	2.82	6445
Crackers	12	2.08	1.91	.21	.20	1.47	3970
	8	3.13	2.88	.32	.29	2.21	5930

DIETARY STANDARDS. (JAFFA.)

	Protein, Lbs.	Fat, Lbs	Carbo-hydrates, Lbs.	Fuel Value (Calories).	Nutritive Ratio.
1. Children, 1–2 years (average)	.06	.08	.16	765	1:5.6
2. Children, 2–6 years (average)	.13	.09	.44	1420	5.0
3. Children, 6–15 years (average)	.16	.10	.71	2040	5 2
4. Adult in full health—Playfair	.26	.11	1.17	3140	5.5
5 Active laborers—Playfair	.34	.16	1.25	3630	4 7
6. Man at moderate work—Voit	.26	.12	1.10	3055	5 3
7. Man at hard work—Voit	.32	.22	.99	3370	4.7
8. Man with little physical exercise—Atwater	.20	.20	.66	2450	5 5
9. Man with light muscular work—Atwater	.22	.22	.77	2800	5.7
10. Man with moderate work—Atwater	.28	.28	.99	3520	5.8
11 Man with active work—Atwater	.33	.33	1.10	4060	5.6
12. Man with hard work—Atwater	.39	.55	1 43	5700	6.9
13. Subsistence diet—Playfair	.13	.03	.75	1760	6.3
14. Average of 7 dietaries of professional men, Europe	.25	.22	.63	2670	4.7
15. Average of 5 dietaries of professional men, United States	.27	.34	1.08	3925	6 6

SUMMARY OF AMERICAN DIETARY STUDIES.

(BRYANT.)

Families Studied.	Av. Food Consump p. Man p. Day				
	Cost, Cents.	Protein, Grams.	Fat, Grams.	Carbo-hydrates, Grams.	Fuel Value, Calories.
Average of 2 laborers' families in comfortable circumstances	19	120	157	534	4045
Average of 15 college clubs in Me., Conn., Tenn., and Mo	...	107	148	459	3690
Average of 10 farmers' families in Vt., Conn., and N. Y.	....	97	130	467	3515
Average of 14 mechanics' families in Conn., N. J., Tenn., and Ind	19*	103	150	402	3465
Average of 12 negro families in Ala.‡	9	67	134	453	3375
Average of 5 French-Canadian families in Chicago, Ill.‡	22	118	158	345	3365
Average of 14 professional men's families in Conn., Pa., Ind., and Ill	28†	104	125	423	3325
Average of 4 families of Russian Jews in Chicago, Ill.‡	10	120	101	406	3095
Av. of 4 Italian families in Chicago, Ill.‡	16	103	111	391	3060
Average of 11 poor families in N. Y. City	15	93	95	407	2915
Av. of 12 laborers' families in N. Y. City	19	101	116	344	2905
Average of 8 Bohemian families in Chicago, Ill.‡	12	115	101	360	2865
Average of 2 laborers' families in Pittsburg, Pa., very poor	11	80	95	308	2485

* Average of 9 studies. † Average of 5 studies.

‡ Food purchased; in the other averages the food actually eaten is given.

DIAGRAMS OF CUTS OF MEAT.

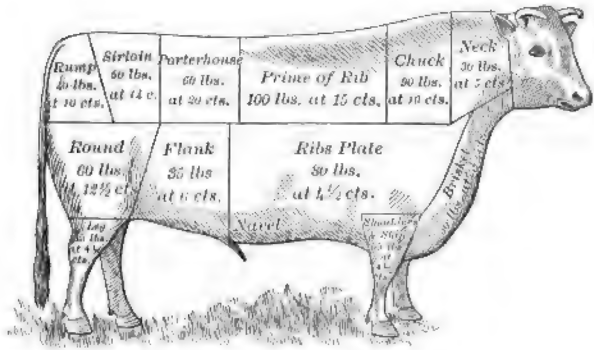
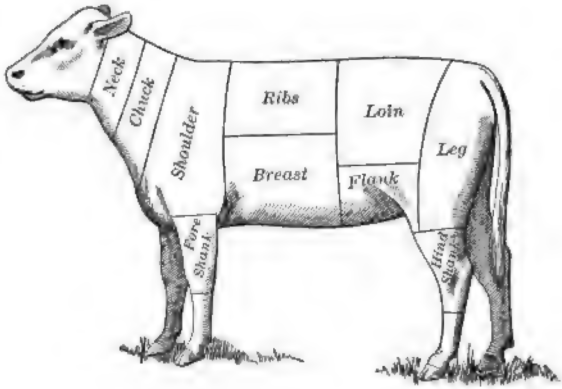


Diagram I. A Good Steer's Carcass, as Cut Up and Priced in the Eastern Market.

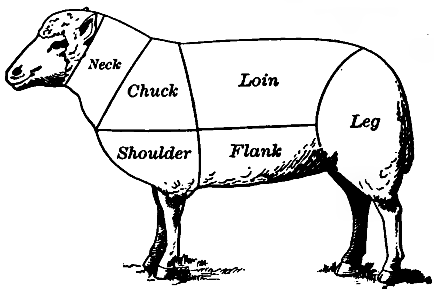
A good 1200-pound steer will dress about 800 pounds of beef cut up as above—715 pounds salable cuts, with 85 pounds of fat, bone, and waste.

The diagram illustrates what the breeder and feeder should aim to produce in the conformation of the beef- and mutton-producing animal, so that the highest possible percentage of the carcass will be cuts of the high-priced class, thereby giving the best possible return for food consumed. (McKerrow.)

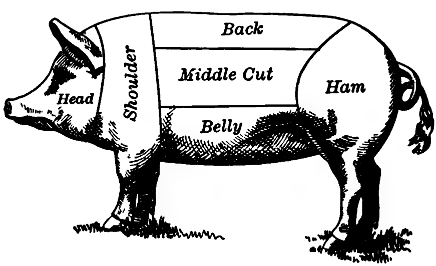
The methods of dividing up the carcasses of slaughtered animals into parts, and the terms used for the "cuts," as these parts are commonly called, vary considerably in different localities. The accompanying diagrams will make clear the terms used in the table Composition of Human Foods (pp. 197–199).



II. Diagram of Cuts of Veal.*



III. Diagram of Cuts of Mutton.*



IV. Diagram of Cuts of Pork.*

* U. S. Dept. of Agriculture.

LIVE WEIGHT AND DRESSED WEIGHT OF STEERS OF DIFFERENT BREEDS AND AGES. (Henry.)

(*Smithfield Show*, 1888-95.)

Breed and Age.		No. of Animals.	Aver. Age.	Aver. Daily Gains.	Live Weight at Slaughtering.	Dressed Weight.
			Days	Lbs	Lbs.	Per Ct
Shorthorn,	1 year olds..	5	642	2.11	1355	66.1
	2 " " .	18	963	1.92	1842	67.5
	3 " " ..	16	1321	1.72	2251	69.4
Hereford,	1 " " ..	16	663	1.97	1308	65.1
	2 " " ..	13	1020	1.78	1817	67.2
	3 " " ..	8	1349	1.64	2218	69.2
Devon,	1 " " .	13	634	1.75	1112	66.0
	2 " " ..	19	1045	1.51	1583	67.7
	3 " " .	16	1311	1.37	1796	67.3
Aberdeen Angus,	1 " " ..	26	668	2.04	1366	65.4
	2 " " ..	21	1008	1.74	1765	66.7
	3 " " ..	2	1346	1.59	2138	67.4
Sussex,	1 " " ..	17	677	2.15	1452	65.4
	2 " " ..	18	989	1.86	1837	68.2
	3 " " ..	12	1285	1.61	2064	68.0
Red Poll,	2 " " ..	12	1002	1.64	1631	65.7
	3 " " ..	6	1362	1.49	2022	65.8
Galloway,	2 " " ..	7	1027	1.64	1688	64.5
	3 " " ..	4	1344	1.47	1969	64.8

PROPORTION OF BEEF TO THE LIVE WEIGHT OF CATTLE. (McConnell.)

	Live Weight, Pounds Avoirdupois.	Per Cent of Beef.		
		Class I.	Class II.	Class III
Heifers	Under 2520	70.72	66.69	....
Steers....................	" 2520	69.71	66.69	... ...
Steers....................	1680–2100	66.68	63.65	63.66
Heifers...................	1400–1680	66.68	63.65	63.66
Steers....................	1400–1680	62.65	60.62	57.62
Heifers...................	1260–1400	62.65	60.62	57.62
Steers....................	1260–1400	57.61	54.59	51.56
Heifers...................	1120–1260	57.61	54.59	51.56
Steers....................	1120–1260	53.56	50.53	48.50
Heifers	980–1120	53.56	50.53	48.50
Heifers	Under 980	....	....	45.47

COMPARATIVE RESULTS OBTAINED WITH FATTENING ANIMALS. (Lawes and Gilbert.)

(*a*) *Per* 100 *lbs. live weight per week.*

	Received by Animal.		Results Produced.		
	Total Dry Food.	Digestible Organic Matter.	Food Consumed for Heat and Work.	Dry Manure Produced.	Increase in Live Weight.
	lbs.	lbs.	lbs.	lbs.	lbs.
Oxen	12.5	8.9	6.86	4.56	1.13
Sheep........	16.0	12.3	9.06	5.10	1.76
Pigs.........	27.0	22.0	12.58	4.51	6.43

(*b*) *In relation to food consumed.*

	Increase in Live Weight.		On 100 lbs. of Dry Food.		
	Per 100 lbs. Dry Food.	Per 100 lbs. Digested Organic Matter.	Consumed for Heat and Work.	Dry Manure Produced.	Dry Increase Yielded.
	lbs.	lbs.	lbs.	lbs.	lbs.
Oxen	9.0	12.7	54.9	36.5	6.2
Sheep........	11.0	14.3	56.6	31.9	8.0
Pigs..	23.8	29.2	46.6	16.7	17.6

LIVE WEIGHT AND GAINS MADE BY SWINE.

(Henry and Sanborn.)

Live Weight.	No. of Animals.	Aver. Live Weight.	Feed Eaten.	Daily Gain Made.	Feed per Lb. of Gain.	Per 100 Lbs. Live Weight.	
						Feed Eaten.	Gain Made.
Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Under 50	59	37.7	2.31	.701	3.30	6.13	1.86
50–100	91	75.5	3.33	.900	3.70	4.41	1.19
100–150	119	126.1	4.29	1.029	4.17	3.40	.82
150–200	138	176.2	6.45	1.123	5.75	3.66	.64
200–250	65	214.1	6.89	1.287	5.35	3.22	.60
250–300	41	266.4	7.64	1.457	5.24	2.87	.55
300–350	12	333.0	6.02	1.352	4.45	1.81	.41
	525						

PROPORTIONS OF THE VARIOUS PARTS OF CATTLE, SHEEP, AND SWINE.

(LAWES AND GILBERT.)

	Ox.			Fat Calf.	Sheep.					Swine.	
	Well Fed.	Half Fat.	Fat.		Lean.	Well Fed.	Half Fat.	Fat.	Very Fat.	Well Fed.	Fat.
Contents of stomach and intestines	18.0%	15.0%	12.0%	7.0%	16.0%	15.0%	14.0%	12.0%	10.0%	7.0%	5.0%
Blood	4.7	4.2	3.9	4.8	3.9	3.9	3.6	3.2	3.2	7.3	3.6
Skin and horns	8.4	7.4	6.0	6.8	9.6	9.3	8.0	7.2	6.5	......	......
Legs to gambrel joint	1.9	1.7	1.6	1.9						......	......
Washed wool	......	......	......	......	5.0	4.7	4.3	4.0	3.6	......	......
Wool dirt	......	......	......	......	4.8	4.5	4.0	3.6	3.2	......	......
Head	2.8	2.7	2.6	4.8	4.6	4.3	3.7	3.2	2.8	....	....
Tongue and gullet	0.6	0.6	0.5							0.5	0.4
Heart	0.4	0.5	0.5	0.6	0.4	0.3	0.4	0.3	0.2	0.5	0.3
Lungs and windpipe	0.7	0.7	0.6	1.2	1.5	1.5	1.2	1.0	1.0	1.4	0.9
Liver and gall-bladder	1.5	1.3	1.3	1.6	1.4	1.3	1.3	1.3	1.0	2.6	1.7
Diaphragm	0.5	0.5	0.5	0.4	0.3	0.3	0.3	0.2	0.2	.....	......
Spleen	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.1	0.1	0.2	0.2
Stomach, without contents	4.5	3.0	2.7	1.2	2.4	2.3	2.3	2.0	1.5	1.2	0.7
Intestines, without contents	2.0	1.5	1.4	2.4	2.3	2.2	1.9	1.7	1.3	3.9	2.2
Fat of omentum and intestines	2.3	2.9	4.5	2.4	3.0	4.1	4.9	6.8	8.0	1.7	2.5
Four quarters, including kidneys and kidney fat	47.4	55.7	60.3	60.0	43.3	45.3	49.4	52.8	57.1	72.8	82.1
Loss	4.1	2.1	1.4	4.6	1.3	0.8	0.5	0.1	0.3	0.9	0.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
SUMMARY.											
Blood	4.7	4.2	3.9	4.8	3.9	3.9	3.6	3.2	3.2	7.3	3.0
Skin, head, legs, and tongue	13.7	12.4	10.7	13.5	24.0	22.8	20.0	18.0	16.1	......	.....
Entrails	9.8	7.7	7.2	7.7	8.5	8.1	7.7	6.6	5.3	9.8	6.0
Flesh and fat	49.7	58.6	64.8	62.4	46.3	49.4	54.3	59.6	65.1	74.5	84.6
Contents of stomach and intestines	18.0	15.0	12.0	7.0	16.0	15.0	14.0	12.0	10.0	7.0	5.0

PROPORTIONS OF THE VARIOUS PARTS OF CATTLE, SHEEP, AND SWINE.—*Continued.*

	Ox.			Fat Calf.	Sheep.					Swine.	
	Well Fed.	Half Fat.	Fat.		Lean.	Well Fed.	Half Fat.	Fat.	Very Fat.	Well Fed.	Fat.
CONSTITUENTS OF CARCASS.											
(DRESSED WEIGHT, INCLUDING FAT OF OMENTUM, ETC.)											
Flesh, without fat and bones	36.0%	38.0%	35.0%	43.0%	33.2%	33.5%	33.1%	29.0%	27.%0	46.4%	40.0%
Bones	7.4	7.3	7.1	9.3	7.1	6.6	5.9	5.5	5.2	8.0	5.8
Fat in flesh	2.0	7.9	14.7	5.5	2.0	3.3	8.0	14.7	20.5	16.5	32.4
Fat on kidneys	2.0	2.5	3.5	2.2	1.0	1.9	2.4	3.6	4.4	1.9	3.9
Fat on omentum and intestines	2.3	2.9	4.5	2.4	3.0	4.1	4.9	6.8	8.0	1.7	2.5
Total	47.7	58.6	64.8	62.4	46.3	49.4	54.3	59.6	65.1	74.5	84.6
FLESH OF CARCASS WITHOUT FAT AND BONES.											
Dry matter	8.0	8.4	7.5	8.8	6.8	6.7	6.3	5.4	5.1	8.1	7.3
Water	28.0	29.6	27.5	34.2	26.4	26.8	26.8	23.6	21.9	38.3	32.7
Total	36.0	38.0	35.0	43.0	33.2	23.5	33.1	29.0	27.0	46.4	40.0
IN 100 PARTS OF FLESH WITHOUT BONES.											
(BUTCHERS' MEAT.)											
Fat	5.3	17.2	29.4	11.3	5.7	9.0	19.5	33.6	43.2	26.2	45.5
Muscle substance	19.8	17.5	14.5	17.0	18.0	17.1	14.5	11.7	10 2	12.3	9.7
Ash	1.2	0.9	0.8	1.1	1.3	1.1	0.8	0.7	0.6	0.6	0.4
Water	73.7	64.4	55.3	70.6	75.0	72.8	65.2	54.0	46.0	60.9	44.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

PROPORTIONS OF THE VARIOUS PARTS OF CATTLE, SHEEP, AND SWINE.—*Continued.*

	Ox.			Fat Calf.	Sheep.					Swine.	
	Well Fed.	Half Fat.	Fat.		Lean.	Well Fed.	Half Fat.	Fat.	Very Fat.	Well Fed.	Fat.
COMPOSITION OF LIVE ANIMALS.											
Fat	7 1%	14.9%	26.8%	13.1%	8 6%	13.2%	18.3%	28.1%	37.2%	22.5%	40.2
Protein	15.8	15.5	13.7	15.3	15.4	14 8	13.8	12.2	10.0	13.9	11.0
Ash	4 8	4.4	3.9	4.5	3.4	3.3	3.2	2.9	2.8	2.7	1 8
Water	54.3	50 2	43.6	60.1	56.6	53.7	50.7	44.8	39.0	53.9	42.0
Contents of stomach and intestines	18.0	15.0	12.0	7.0	16 0	15.0	14.0	12.0	10.0	7.0	5.0
Total	100 0	100.0	100.0	100 0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
THE SAME, LESS CONTENTS OF STOMACH AND INTESTINES.											
Fat	8 7	17 5	30.5	14.1	10.2	15.5	21.3	31.9	41.4	24.2	42.3
Protein	19.2	18 3	15 6	16 5	18 3	17.4	16.0	13.9	12.2	15 0	11.9
Ash	5.9	5 2	4 4	4.8	4.0	3 9	3 8	3.3	3.1	2.9	1 9
Water	66 2	59.0	49.5	64.6	67.5	63.2	58.9	50.9	43.3	57.9	43.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
MINERAL MATTERS IN 100 PARTS OF LIVE ANIMAL.											
Phosphoric acid	1.92	1.76	1.56	1.64	1.33	1.29	1.25	1.13	1.09	1.10	0.73
Lime	2.14	1.96	1.74	1.93	1.40	1.35	1.31	1.19	1.15	1.15	0.77
Magnesia	0.06	0 06	0.05	0.06	0 05	0 04	0.04	0.04	0.04	0.05	0.03
Potash	0.18	0.16	0 14	0.29	0.16	0.16	0.15	0.14	0.13	0 15	0.10
Soda	0.14	0.13	0.12	0.07	0.15	0.15	0.14	0.13	0.12	0.10	0 07
Silica	0.02	0.01	0.01	0.01	0.02	0 02	0.02	0.02	0.02	.....	.....
Sulfuric acid, chlorin, and carbonic acid	0.34	0.32	0.28	0.50	0.29	0.29	0.29	0.25	0.25	0.15	0.10
Total	4.80	4 40	3.90	4.50	3.40	3.30	[illegible]	2.90	2.80	2.70	1.80

PART II. DAIRYING.

I. DAIRY COWS.

ON THE ORIGIN AND CHARACTERISTICS OF THE DIFFERENT BREEDS OF DAIRY CATTLE.

I. Jersey Cattle.

The origin of the Jersey cattle, like many of our other improved breeds of live-stock, is not known with certainty. The theory is that they descend from cattle brought from the Scandinavian countries to Normandy France, during the tenth century or before, whence they were introduced into the Island of Jersey, off the French coast. The breed has been kept pure on this little island for a longer period than any other English breeds, as a result of the enactment in 1789 of a law forbidding importations of foreign cattle into the island. According to Flint, Jerseys were first imported into this country about 1838, but heavy importations did not begin until after 1850.

The following is a description of typical Jersey cows: Head fine and tapering; cheek small; throat clean; the muzzle fine and encircled with a slight stripe; the nostril high and open; the horns smooth, crumpled, not very thick at the base, tapering, and tipped with black; ears small and thin, deep orange color inside; eyes full and placid; neck straight and fine; chest broad and deep; barrel hooped, broad and deep, well ribbed up; back straight from the withers to the hip, and from the top of the hip to the setting on of the tail; tail fine, at right angles with the back, and hanging down to the hocks; skin thin, light color, and mellow, covered with fine soft hair; forelegs short, straight and fine below the knee, arm swelling and full above; hind quarters long and well filled; hind legs

short and straight below the hocks, with bones rather fine, squarely placed, and not too close together; hoofs small; udder full in size, in line with the belly, extending well up behind; teats of medium size, squarely placed and wide apart, milk veins very prominent; color is generally cream, dun, or yellow, with more or less white.

The Jerseys are generally considered a butter-producing breed, and justly so. The milk produced is as a rule richer in fat and solids than that of any other breed, but the quantity yielded, on the other hand, is apt to be lower. Milk from good Jersey cows often contains over six per cent of fat, the average being about five per cent. Production of rich milk has been the primary aim of Jersey breeders; in 1881 the secretary of the American Jersey Cattle Club wrote: "The sole office of the Jersey cow is to produce the largest possible amount of rich, highly colored cream from a given amount of food. Everything else in connection with the breeding of the race is, or should be, incidental."

The highest yields of butter-fat or butter, in case of Jersey cows as well as other dairy breeds, are not, however, apt to come from cows producing exceptionally rich milk, but rather from such producing an exceptionally large quantity of good milk; generally speaking, an extraordinarily high fat-content is accompanied by a small milk yield.

Typical Jerseys generally have a high-strung, nervous temperament, and in order to do their best must receive good care; they cannot be abused as to feed or treatment without injury; for this reason they will only prove a success in the hands of intelligent feeders who care for and take an interest in their stock. The dairy type predominates, viz.: a wedge-shaped, deep-chested body, with good digestive organs, large full udders, well-developed milk-veins, and a soft, mellow skin. The cows are gentle and docile, while the bulls have the reputation of being hard to handle, and often ugly and dangerous after a couple of years' service.

The maximum yields of milk and butter produced by Jersey cows are given on page 240, the table giving the

official records. In the breed-tests conducted by the experiment stations in Maine, New Jersey, and New York (Geneva), the Jerseys have ranked among the first, but have seldom been the foremost. As the average of all tests of dairy breeds up to date, we notice that the Jerseys rank after the Shorthorns and the Guernseys in total yield of fat during a full period of lactation, and after Guernseys in the cost of producing one pound of fat; they rank first as to richness of milk produced. In the English milking trials conducted by the British Dairy Farmers' Association, the Shorthorn cows have generally led the Jerseys in the total quantities of fat produced per day, and other breeds have also, on the average, given better results than these. The Jerseys came out victorious in the breed-tests conducted at the World's Columbian Exposition in 1893; they produced more milk, butter-fat, butter, and cheese, and gave a higher net gain than either of the two other breeds competing (Guernsey and Shorthorn); the Guernseys, on the other hand, led as regards the cost of the food consumed. Also in the Dairy Cow Demonstration at the La. Purchase Exposition in St. Louis, in 1904, the Jersey cows produced more butter-fat, on the average, than either of the other competing breeds, and at a lower feed cost per pound (see p. 239). The champion Jersey cow in this demonstration, Loretta D., produced in 120 days 5802.7 lbs. milk; average per cent of fat, 4.82; 280.16 lbs. butter-fat, equivalent to 330 lbs. of butter, and an average daily production of 2.334 lbs. butter-fat.

The American Jersey Cattle Club was organized in July, 1868; the *Herd Register* of the club, the first volume of which was published in 1871, has been issued in seventy-two volumes up to date, including in all 92,000 bulls and 244,000 cows. *Register of Merit of Jersey Cattle* gives records of all Jersey cows and bulls entered in the *Register of Merit*, which was established by the club in 1903; the latest volume published is Vol. III, containing entries to Nov. 10, 1913.

The present Secretary of the American Jersey Cattle Club is R. M. Gow, No. 324 W. 23d St., New York City.

II. Guernsey Cattle.

By Prof. W. H. Caldwell, Peterboro, N. H., Sec'y Am. Guernsey Cattle Club.

The Guernsey breed takes its name from the Island of Guernsey, one of the Channel, or sometimes termed Alderney, Islands. The origin of the Channel Island cattle, while somewhat involved in controversy, is generally believed to have come from stock originally from the French provinces of Normandy and Brittany, and that the foundation for the Guernseys was laid by crossing the Normandy bull on the Brittany cow. It is very interesting to turn to the Island of Guernsey, cut off as it is from the main land by the little strip of sea, and protected on all sides by a rough, rocky coast, and note the characteristics which we find there that have played so important a part in moulding the character of the Guernsey of to-day. There the shrewd, careful, sturdy people have labored many years to produce a cow that should excel in butter production. Their labors have been rewarded in the Guernsey, which is noted the world over for producing butter of the highest natural color and with the least outlay for cost of feed. Fate might have been different with these people but for their insular situation, pride of self-government, habits and customs, which led them to zealously fight invasions, and even as early as 1789 to take measures against the fraudulent importation of stock. In 1826 came more stringent laws, that prohibited importation to the island except for slaughter. It thus isolated the islanders and their cows from the cattle kingdom.

The striking appearance of the Guernsey is at once seen in its rich yellow skin, which has always been noted as the characteristic of a good butter-cow. In appearance they are rangy, deep, business-looking animals, with a particularly quiet, gentle, tractable temperament, free from nervousness. The prevailing color is a delicate shade of fawn with white markings, and cream-colored nose; and their most remarkable characteristic of richness is apparent in the

golden color around the eye, on the udder and teats at base of horn, and at end of the bone of tail.

Until recently Guernseys in America were kept chiefly for family use. They were introduced into private dairies around Philadelphia as early as 1840, and since that time no other breeds have been permitted to replace them. The gentlemen who first introduced Guernseys had no motive to advertise them. They esteemed their golden-colored products so highly that they were kept for the supplying of families with the best milk and butter that could be produced. About 1865 a few Guernseys were introduced by the importers, which laid the foundation of some of our herds of to-day. A few years later the Massachusetts Society for the Promotion of Agriculture, realizing the great promise of the breed, imported some and distributed them at a public sale to dairymen in the State. A few years later a number of Connecticut farmers joined together and sent a man to the island to bring over a lot. It soon became obvious to these gentlemen that some organization was necessary to preserve the purity of these cattle and to encourage their recognition. Accordingly on February 7. 1877, the American Guernsey Cattle Club was organized in New York City. At that time there were about one hundred and fifty pure-bred Guernseys in the country, whose pedigrees could be traced without question to importation from the island. At present there are about 60,000 animals in the Register. In the last few years—in fact since the World's Fair Dairy tests in 1893, and the work at the New York and New Jersey Experiment Stations—great interest has been taken in the Guernseys. More entries and transfers have been recorded, and more members have joined the Club than at any similar period in its history. The public are just realizing the straightforward work that has been quietly done for the last quarter of a century, and find in a study of it that there are many valuable records to the credit of the breed. These are all the more valuable as the Guernsey has not been forced for high records, but have honestly won their way.

The best records reported of Guernseys are those of Lily

of Alexandre, No. 1059, and Imp. Bretonne, No. 3660. Lily of Alexandre gave 12,855½ pounds of milk in one year; and two months before calving tested 7.2 per cent of butter-fat. Bretonne gave in the year ending October 20, 1894, 11,219 pounds of milk. Her milk was tested carefully once a month by taking a composite sample of eight consecutive milkings. The lowest test was 5.2 per cent and highest 6.1 per cent butter-fat. Her milk yielded 602$\frac{21}{100}$ pounds of butter-fat, or equivalent to 753$\frac{5}{10}$ pounds of butter containing 80 per cent butter-fat. She is a large, well-built cow, and weighed at the close of her year's work 1150 pounds. In addition the cow Fantine 2d, No. 3730, owned by Mr. Chas. Solveson of Nashotah, Wis., gave in one year, besides dropping a fine calf and being dry four weeks, 9748 pounds of milk, the lowest test being 5 and the highest 5.6 per cent butter-fat, which would yield a year's record of 516.6 pounds butter fat or 602 pounds of butter. Mr. Ezra Michener of Carversville, Pa., owns the cow King's Myra, No. 5339, who has just completed the year's test under the direction of the Guernsey Breeders' Association and received their first prize. She is four years old, and gave in the year 8611 pounds of milk, which yielded 539 pounds of butter. Nearly a hundred cows have been reported that have made a record of 14 pounds or over of butter a week, and several that have made exceedingly fine single-day tests, as one cow, Pretty Dairymaid 2d of Guernsey, No. 6366, who in an official test gave in three consecutive days 61 pounds 2 ounces, 62 pounds 12 ounces, and 52 pounds and 9 ounces of milk, a total of 176 pounds 7 ounces.

Their ability to produce butter-fat and butter at a low cost demands the careful attention of the dairymen. At the New York Experiment Station several of the dairy breeds are being carefully tested. The annual report of the director, which was recently issued, gives the result of the first two periods of lactation. In both instances the Guernseys produced butter-fat at the least cost, as the following shows:

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COST OF BUTTER-FAT PER POUND, CENTS.

Breed.	N. Y. (Geneva.) Lactation Period.		New Jersey.*	World's Fair.*
	First.	Second.		
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Jersey	20.0	18.5	17.9	13.3
Ayrshire	24.3	24.8	20.6	...
Shorthorn	....	....	20.8	15.8
Holstein	26.3	26.4	22.4	....
Devon	23.0	19.0	....	....
Am. Holderness	26.3	22.8	....	....

* Cost of butter per pound.

This shows the Guernseys to be the most economical producers of butter; and such golden-yellow butter, too!

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III. Holstein-Friesian Cattle.

By Malcolm H. Gardner, Delavan, Wis., Supt. Advanced Registry Holstein-Friesian Association of America.

The cattle known in America as Holstein-Friesians belong to the shorthorn, low-land race, native to the fertile lands of Europe bordering on the North Sea; of which race, from the dairy standpoint, the Holstein-Friesian family is the most highly developed. These cattle might have been better named Friesian, since Friesland, and the neighboring provinces of Holland, is the central home from which this breed of cattle has been so widely disseminated over the Old World, and from which some 10,000 head of foundation stock has been brought to America. The Friesian people are among the most conservative of the Germanic race; still holding to and speaking among themselves the old Friesian language, although also able to speak Dutch, the official language of Holland. They have been equally conservative in holding to their ancient industry of cattle-rearing, an occupation for which their low-lying lands are especially fitted; and as Tacitus speaks of them nearly 1900 years ago as cattle breeders, paying a tribute in cattle and hides to the Roman Empire, so we find them to-day making dairy husbandry their main industry. Holding mainly to one occupation down through the centuries, and passing the business from father to son, it would be strange indeed if their breed of cattle did not reach a very high degree of development; so it is in no way surprising that we should find these Friesian dairymen possessed of a breed

of cattle which, as an all-around dairy breed, is superior to any other breed known.

While the Holstein-Friesians are essentially a dairy breed and are so regarded in America, yet as an all-around dairy breed the matter of beef and veal must not be lost sight of, and in Holland these are very important points. There few cattle are allowed to pass their seventh year; but before they pass out of their prime they are fattened and sold as beef. Prof. I. P. Roberts in speaking of Holstein-Friesian beef said: "I ate it for three weeks, and the English beef for two; and while not so fat as the short-horn, it was to my taste superior." The breed reaches full growth and maturity at about five years of age; reaching full height at between two and one-half and three years of age, and each year for the two following years adding about one and three-fourth inches in length, three-fourths of an inch in width of hips, and two inches in girth of chest. Mr. S. Hoxie, former Supt. of H.-F. Advanced Registry, states that the average measurements of cows upwards of five years of age received to entry in the fourth volume of the Advanced Register were as follows: "Height at shoulders, 51.8 inches; height at hips, 53 inches; length of body, 64.9 inches; length of rump, 21.4 inches; width of hips, 21.9 inches; width at thurl, 19.6 inches; girth at smallest circumference of chest, 75.6 inches." The average weight of these cows was 1262 lbs., and the average measurements are those of what might be deemed a typical animal of what is technically known as the milk-and-flesh form of the breed, the form most popular in America.

The first association of breeders of these cattle in this country was formed in 1871, the first herd-book being published the following year. The present Holstein-Friesian Association was formed in 1885 by the union of two earlier associations, and is now the largest association of breeders of pure-bred dairy cattle in America. How many H.-F. cattle there are now living is unknown; but since the juncture of the two old associations in 1885, over 180,000 females and 96,000 males have been recorded. The *H.-F. Advanced Register*, based for entry upon individual merit, was established in 1885; 23 volumes having been published, containing entries of over 18,500 cows and 1300 bulls. The age of any female is computed as that at the time of last calving

or aborting, and the requirements for entry vary with the age, being not less than 7.2 lbs. butter-fat in seven consecutive days for a heifer calving at just two years of age or younger, and increasing proportionately to not less than 12 lbs. butter-fat for a cow calving at five years old or older; there being no increased requirements for increased age after a cow reaches the age of five years. Only bulls having four or more daughters which have been entered in the Advanced Register on official records of butter-fat are accepted for entry.

The rules for the entry of cows in the H.-F. Advanced Register are very stringent, being designed to place every H.-F. record beyond even a shadow of doubt. Every milking during the period of test is watched, weighed, sampled, and tested by a representative of a State Agricultural College; and thus, because of resulting expense, the bulk of its records are for short periods, mainly for one week. It will be readily admitted that 18 lbs. of butter-fat will make 21 lbs. of the best of butter, or an average of three pounds butter per day when 18 lbs. of fat is produced in seven consecutive days, and that very few cows other than Holstein-Friesian have ever under strict rules produced such an amount. The records of the H.-F. Advanced Register show that 224 H.-F. cows have produced officially in excess of 18 lbs. butter-fat; of which 82 cows have produced between 18 and 19 lbs.; 64 cows, between 19 and 20 lbs.; 46 cows, between 20 and 21 lbs.; 15 cows, between 21 and 22 lbs.; 8 cows, between 22 and 23 lbs.; 6 cows, between 23 and 24 lbs.; 1 cow, between 24 and 25 lbs.; 1 cow, between 25 and 26 lbs.; and 1 cow, over 27 lbs. It must be remembered that while many of these records were made by cows much under five years of age, there were a large number of records made by two and three-year-old heifers, which were, considering age, proportionately as large, yet fell short of the 18-lb. limit required for this list.

As to the per cent of fat in average H.-F. milk, 1545 cows and heifers of all ages entered in the 17th volume of the H.-F. Advanced Register, of which more than one-half were heifers, produced in seven consecutive days an average of 376.7 lbs. milk, containing 12.75 lbs. butter-fat, showing an average of 3.39 per cent fat. There were 71 cows and heifers producing over 18 lbs. butter-fat; and these cows averaged 540.9 lbs. milk,

containing 19.758 lbs. butter-fat, showing an average of 3.65 per cent fat. Eighty-three H.-F. cows and heifers have made 30-day official records exceeding 72 lbs. butter-fat, of which 24 made from 72 to 76 lbs.; 27, from 76 to 80 lbs.; 18, from 80 to 85 lbs.; 6, from 85 to 90 lbs.; 6, from 90 to 100 lbs.; 1, from 100 to 110 lbs.; and 1 made over 110 lbs. of butter-fat.

A few H.-F. cows have been officially tested for longer periods; and one cow produced in 100 days over 284 lbs. fat, while a heifer under three years of age produced over 227 lbs. in the same length of time. At the World's Fair at St. Louis, where three Missouri H.-F. breeders pitted their individual herd against the pick of the Jersey world, one H.-F. cow produced over 282 lbs. fat in 120 days, surpassing the foremost Jersey by over two pounds; and since then a H.-F. cow has produced officially over 316 lbs. fat in the same time. One H.-F. cow has produced over 453 lbs. fat in 182½ days, while another produced over 721 lbs. fat in one year. This last was owned by the Michigan Agl. College. Prof. Oscar Erf, Kansas Agl. College, writes that one of their H.-F. cows has produced nearly 16,000 lbs. of milk in one year, testing from 3.2 to 3.7 per cent fat, and that at the end of the year she was still giving from 25 to 30 lbs. milk per day; while Prof. A. L. Haecker, Nebraska Agl. College, states that a heifer calving at just past three years has given in 39 weeks 15,063.9 lbs. milk, containing 492.05 lbs. butter fat, and that she was still giving 45 lbs. milk per day, with 13 weeks before her in which to complete the year's record. A heifer, calving at just past three years of age, in semi-official test under the rules of the Wisconsin Exp. Station, produced in one year, 13,213.6 lbs. milk containing 584.080 lbs. butter-fat. Many H.-F. cows have made very large private records; but it is not the practice of the H.-F. Association to report private records.

It has been asserted by some persons illy posted as to the facts, that while H.-F. cows did yield large quantities of milk, the milk was below standard in quality. Ten gallons of milk per day, by weight 84 lbs., might be considered more than any cow could ever produce; yet under the strictest official test 40 H.-F. cows have yielded in excess of 588 lbs. in a period of seven consecutive days. This herd of 40 cows, of which some were not of full age, produced in a period of seven consecutive days 25,032.2 lbs. milk, containing 821.497 lbs. butter-fat; thus showing an average

of 3.28 per cent fat. The average for each cow was 625.8 lbs. milk, containing 20.537 lbs. butter-fat, equivalent to 89.4 lbs. milk (over 10½ gallons) per day, and nearly 24 lbs. of commercial butter per week. After such proofs of large production of both butter-fat and of milk, and showing that even in the largest yields of almost incredible amounts of milk the content of butter-fat was 10 per cent in excess of the usual legal requirements, further comment would seem unnecessary.

Owners and breeders of Holstein-Friesian cattle base their claims for the superiority of this breed over all other dairy breeds mainly on the following points: First, that the Holstein-Friesian is a large, strong, vigorous cow, full of energy and abounding in vitality; second, that her physical organization and digestive capacity are such that she is able to turn to the best advantage the roughage of the farm, converting the same into merchantable products; third, that she yields large quantities of most excellent milk, fit for any and all uses, and especially well fitted for shipping purposes; fourth, that heredity is so firmly established through her long lineage that she is able to perpetuate herself through the production of strong, healthy calves; and fifth, that, when for any reason her usefulness in the dairy is at an end, she fattens readily and makes excellent beef.

IV. Ayrshires.

By C. M. Winslow, Brandon, Vt., Secretary Association of Ayrshire Breeders.

The original home of the Ayrshire cow is in Scotland, in the county of Ayr. This county has always been noted for its dairy industry and the thrift of its inhabitants. The soil is strong, giving good pasturing and abundant crops, the climate is rough, and people and cattle hardy.

The Ayrshires began to attract the attention of dairymen in other parts of the world some sixty years ago, and there was an importation made into Canada and the New England States, where they are bred in considerable numbers and highly prized. They have been sent South, and are said to endure the heat better than any other breed. They also are said to stand the cold of Canada better than any other dairy breed.

The Ayrshire cow is of medium size, weighing about one thousand pounds, of blocky build, low on legs, and usually

spotted in color, being red and white as a rule, though sometimes nearly red or nearly white. They are hardy and healthy, enduring changes of heat and cold with little discomfort, and quickly adapt themselves to surrounding conditions. They perhaps show to the best advantage where the food-supply is limited and they are compelled to hunt for a full supply.

It is claimed for the cows of this breed that they will give the largest return of dairy product for food consumed of any of the dairy breeds. There has never been much said or done by the owners of Ayrshires to bring their merits to the attention of the public. They are a popular cow for the milkman, because they are economical producers and give milk of good quality that satisfies the trade.

High-grade Ayrshire cows always command the highest fancy price in Brighton, to go into the stables of milk producers. It is said by the milk inspectors of Boston that they have no trouble with the milk from Ayrshire herds, it being up to the 13 per cent total solids required by Massachusetts law.

The average yield of Ayrshire cows is a little over 6000 lbs. of milk in a year, on ordinary dairy food and care, but there are a large number of individual cows with authenticated records all the way from 7000 lbs. to over 12,000 lbs. of milk in a year.

It is only within a very few years that the Ayrshire Breeders' Association instituted a system of official tests, and only a few of the breeders have entered their herds, consequently we have the records of a comparatively small number of cows, but enough to show that the Ayrshire cow is by nature a wonderful dairy cow both in milk and butter production, and that it would be an easy matter to produce families of phenomenal cows adapted to the production of either butter or milk.

The association has confined itself chiefly to the yearly tests, believing that it is the long period that shows the staying quality of the breed and the true value of a dairy cow.

We have in the ordinary work of the dairy found a number of cows that gave from fourteen to nineteen pounds of butter in seven days, and from sixty to nearly 100 pounds in the month.

We have compiled from the official files of the association tests the following yields from individual cows:

Milk.—78 cows gave over 8000 lbs. of milk in a year; 51 cows gave over 8500 lbs. of milk in a year; 43 cows gave over 9000 lbs. of milk in a year; 17 cows gave over 9500 lbs. of milk in a year;

the making of the first quality butter for private family hotel use. He believed that on a whole the Guernse were more satisfactory for the dairy than any which in h forty years' experience he had ever had. His cows h good square udders, well set front and behind, teats good size and easy to grasp.

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14 cows gave over 10,000 lbs. of milk in a year; 7 cows gave over 10,500 lbs. of milk in one year; 6 cows gave over 11,000 lbs. of milk in one year; 4 cows gave over 11,500 lbs. of milk in one year; 2 cows gave over 12,000 lbs. of milk in one year; 1 cow gave over 12,500 lbs. of milk in one year.

Butter.—181 cows gave over 300 lbs. of butter each in one year; 87 cows gave over 350 lbs. of butter each in one year; 33 cows gave over 400 lbs. of butter each in one year; 13 cows gave over 450 lbs. of butter each in one year; 5 cows gave over 500 lbs. of butter each in one year; 1 cow gave nearly 550 lbs. of butter in one year; 1 cow has for the last five consecutive years dropped five calves and given an official record of 52,000 lbs. milk and 2130 lbs. butter.

The Ayrshire, being a dairy cow, has never been claimed for beef or even for a general-purpose cow, but her easy keeping-qualities and hardy disposition cause her to lay on flesh rapidly when dry, and she will probably return to her owner in beef the full cost of raising her. Farmers who fatten calves for veal tell me the calves are small when born, but grow rapidly, so that when of age to sell they are large and heavy for their age and are good handlers.

V. Shorthorns as Dairy Cows.

By the late J. H. Pickrell, Springfield, Ill., Secretary American Shorthorn Breeders' Association.

Away back in the early history of this country, there were occasionally cows imported from England. Buffalo and wild game were abundant for meat, but milk, butter, and cheese did not come that way.

As creatures of circumstances, cows were in demand. Soon after the Revolutionary War, cattle that were pure-bred Shorthorns were imported into Virginia, and afterwards, in 1797, found their way into Kentucky. The cows were said to be great milkers, and are reported to have given as much as 32 quarts of milk per day, and were called by the natives "the milk breed." Later importations with more particular reference to their beef qualities were made, but, in spite of all that had been fed into them with that end in view, many of the cows developed into remarkably heavy milkers, and were very noted for their large yield of a good quality of milk.

The late L. F. Allen, in his history of "American Cattle," published in 1868, says: "We have numerous well-

authenticated instances of their (Shorthorns) giving six, seven, eight, and even nine gallons a day, on grass alone, in the height of their season, and yielding fourteen to eighteen pounds of butter per week, and of holding out in their milk in proportionate quantity, as well as other breeds of cows, through the year. Cows so much larger in size than other kinds should be expected to give more than smaller ones that consume less food, and without asserting that they do give more, in proportion to their size, it is claimed that when educated and used for the dairy chiefly, they give quite as much as others. That the inherent quality of abundant milking exists in the Shorthorns, no intelligent breeders of them need doubt. Our own observation in more than thirty years' experience with hundreds of them, first and last, under our own eyes, is to ourself evidence of the fact, both in thoroughbreds and grades."

The Columbian dairy tests, though made under unfavorable circumstances, proved the milking qualities of Shorthorns. I say unfavorable, because the matter was not taken hold of soon enough by the American Shorthorn Breeders' Association, under whose auspices the exhibit was made, to select the best cows in every instance so as to have them bred to produce and have them at their highest flow of milk at the proper time. As a consequence, cows had to be picked up that had produced at hap-hazard, and were not in every instance the best that might have been used, if selections had been made in season to have them bred so as to have them produce just prior to the tests. But with all these disadvantages, the two strictly acknowledged dairy breeds—bred for that purpose almost exclusively—which were selected with the greatest care, so much so that it is doubtful whether they could be duplicated, had but little the advantage of the Shorthorns in the general "round-up," as a few comparisons will prove.

In test No. 1 (cheese), with 25 cows of each breed, the score stood as follows:

Jerseys	906.1	points
Shorthorns	905.5	"
Guernseys	871.9	"

of Alexandre, No. 1059, and Imp. Bretonne, No. 3660. Lily of Alexandre gave 12,855½ pounds of milk in one year; and two months before calving tested 7.2 per cent of butter-fat. Bretonne gave in the year ending October 20, 1894, 11,219 pounds of milk. Her milk was tested carefully once a month by taking a composite sample of eight consecutive milkings. The lowest test was 5.2 per cent and highest 6.1 per cent butter-fat. Her milk yielded $602\frac{21}{100}$ pounds of butter-fat, or equivalent to $753\frac{5}{10}$ pounds of butter containing 80 per cent butter-fat. She is a large, well-built cow, and weighed at the close of her year's work 1150 pounds. In addition the cow Fantine 2d, No. 3730, owned by Mr. Chas. Solveson of Nashotah, Wis., gave in one year, besides dropping a fine calf and being dry four weeks, 9748 pounds of milk, the lowest test being 5 and the highest 5.6 per cent butter-fat, which would yield a year's record of 516.6 pounds butter fat or 602 pounds of butter. Mr. Ezra Michener of Carversville, Pa., owns the cow King's Myra, No. 5339, who has just completed the year's test under the direction of the Guernsey Breeders' Association and received their first prize. She is four years old, and gave in the year 8611 pounds of milk, which yielded 539 pounds of butter. Nearly a hundred cows have been reported that have made a record of 14 pounds or over of butter a week, and several that have made exceedingly fine single-day tests, as one cow, Pretty Dairymaid 2d of Guernsey, No. 6366, who in an official test gave in three consecutive days 61 pounds 2 ounces, 62 pounds 12 ounces, and 52 pounds and 9 ounces of milk, a total of 176 pounds 7 ounces.

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of cattle which, as an all-around dairy breed, is superior to any other breed known.

While the Holstein-Friesians are essentially a dairy breed and are so regarded in America, yet as an all-around dairy breed the matter of beef and veal must not be lost sight of, and in Holland these are very important points. There few cattle are allowed to pass their seventh year; but before they pass out of their prime they are fattened and sold as beef. Prof. I. P. Roberts in speaking of Holstein-Friesian beef said: "I ate it for three weeks, and the English beef for two; and while not so fat as the short-horn, it was to my taste superior." The breed reaches full growth and maturity at about five years of age; reaching full height at between two and one-half and three years of age, and each year for the two following years adding about one and three-fourth inches in length, three-fourths of an inch in width of hips, and two inches in girth of chest. Mr. S. Hoxie, former Supt. of H.-F. Advanced Registry, states that the average measurements of cows upwards of five years of age received to entry in the fourth volume of the Advanced Register were as follows: "Height at shoulders, 51.8 inches; height at hips, 53 inches; length of body, 64.9 inches; length of rump, 21.4 inches; width of hips, 21.9 inches; width at thurl, 19.6 inches; girth at smallest circumference of chest, 75.6 inches." The average weight of these cows was 1262 lbs., and the average measurements are those of what might be deemed a typical animal of what is technically known as the milk-and-flesh form of the breed, the form most popular in America.

The first association of breeders of these cattle in this country was formed in 1871, the first herd-book being published the following year. The present Holstein-Friesian Association was formed in 1885 by the union of two earlier associations, and is now the largest association of breeders of pure-bred dairy cattle in America. How many H.-F. cattle there are now living is unknown; but since the juncture of the two old associations in 1885, over 180,000 females and 96,000 males have been recorded. The *H.-F. Advanced Register*, based for entry upon individual merit, was established in 1885; 23 volumes having been published, containing entries of over 18,500 cows and 1300 bulls. The age of any female is computed as that at the time of last calving

weight, and producing healthy offspring. This I consider a physiological fact well worthy of notice, and very creditable to the 'little red cow.' Of course the same nutritive power applied in other directions would give beef-producing results, such as we all know of."

Devon cattle are active and very hardy, qualities that make them especially valuable in dry or mountainous regions. The bulls are quite intelligent and active, and are not as liable to be cross as some other breeds; they weigh from 1800 to 2000 lbs. at three to four years old. The cows have strong vital organs, and large digestive and assimilating powers. Their udders are not large for the amount of milk they give, with good elastic teats, seldom sore. The milk is of good quality, either as food for infants and invalids, for the manufacture of butter or cheese, or for market delivery; it does not churn in the cans, nor look blue in the bottle.

Devons will pay their way at the dairy as well as in the feeder's stable; they will keep in good condition, and look plump and sleek on pasture that other breeds can hardly live on; they are easy keepers, good producers of the finest kind of milk, and also make the very best quality of beef.

VIII. Dutch Belted Cattle.

By H. B. Richards, Easton, Penna., Secretary Dutch Belted Cattle Association of America.

Dutch belted cattle are natives of Holland, and originated in that country during the seventeenth century, when the cattle interests of Holland were in the most thrifty condition; in fact, it was the chief industry of the country. At that time breeding had been developed to a science, and cattle of remarkable contrast of color were bred whose foundation color was black, with a broad white band around the centre of the body, a white head, a black ring around each eye, and a full white tail. Wonderful and remarkable as it may appear, a feat was accomplished during that period that would defy our modern breeders and can be safely classified as a lost art.

Dutch belted cattle became a classified breed and were

bred to a remarkably high standard. For several centuries they were owned and controlled by the nobility keeping them pure and limiting their number to their ownership. They were first imported into this country about the middle of the present century, the importers procuring the finest herds in Holland; the herds in the United States to-day are purely of American breeding.

The American Association have adopted as their standard of color a pure black, with a continuous white belt around their body, beginning behind the shoulders and extending nearly to the hips; this sharp contrast of colors makes a beautiful and imposing contrast and a most beautiful sight; when seen in number grazing on the green, they are admired by all, even if not interested in cattle or farming. This belt is almost invariably reproduced, and is so perfectly fixed that it will crop out in their grades for many generations, even against cold strains of blood; the potency of this feature is very striking, as the belt is often reproduced after the foundation color is lost; and grades of any foundation color can be produced to an unlimited extent.

Their form is a strong characterized dairy type, medium size, and possessing all the qualifications of an ideal dairy animal. They are strictly a dairy breed, and are large and persistent milkers; strong constitutions, peaceable and quiet dispositions of a very compact form. Cows range from eight to twelve hundred, and bulls reach eighteen to twenty hundred. The late P. T. Barnum, the showman of national fame, said: "They struck my fancy in Holland about 1850; I imported a few, and then found their unique and novel appearance not their only quality, for they proved to be wonderful milkers, far superior to any other cattle to which my attention has been drawn."

Nearly all the herds now in the United States are owned in New York, Pennsylvania, and Massachusetts, with a few scattering South and West. A herd of eighteen were exhibited at the World's Columbian Exposition at Chicago, where they attracted great attention and were admired by thousands who had never heard of such novel and beautiful

cattle before. This herd was sold and exported to a wealthy resident of the City of Mexico, where they are now kept and are doing well in that congenial climate. There is an association of breeders of these cattle known as the Dutch Belted Cattle Association of America, who have adopted a high standard of excellence, requiring breeders to breed typical animals of correct markings, thereby gaining uniformity and correctness of type. The association issues a herd-book, of which vol. 10 of recent issue, is the last number.

IX. Brown-Swiss Cattle.

By N. S. Fish, Groton, Conn., late Secretary Brown-Swiss Cattle Breeders' Association.*

Brown-Swiss cattle were first imported into this country by Mr. Henry M. Clarke of Belmont, Mass., in 1869. He imported seven cows and one bull; since then there have been several importations. Most of the animals have come from the famed Canton of Schwyz, and the adjacent Cantons of Zug, Uri, and Unterwalden. The Rigi mountains, covered to their tops with fine, rich herbage, lie here, and some of the finest breeds of cattle in the whole country are here produced, the cattle grazing in the valley in winter and on the mountains in summer.

The United States consul at Zurich in 1882 made a report to our government of the cattle and dairy interest of Switzerland. He writes: "For a hundred years Switzerland has been famous for the production of its dairies. At the cattle show of Paris, 1878, every Swiss cow exhibited bore away a prize in competition with exhibits from Holland, England, Denmark, and other famous cattle countries.

The Brown-Swiss cattle are fed on grass or hay only the year through. A fair average for cows in Canton Zurich is ten quarts of milk per day the milking-year through; in Schwyz and Zug the average is but little less."

The consul of St. Gall says: "When a farmer in Germany, Italy, or France wishes to improve his breed, he

* Revised by C. D. Nixon, Secretary, Owego, N. Y.

makes a selection from Swiss herds as the healthiest and hardiest known to the herd-book. . . . The Brown-Swiss is considered the dairy breed *par excellence* of Switzerland; it not only gives more milk, but this is richer than any other European breed of cattle."

Marked Characteristics.—Size large; form firm; color shades from dark to light chestnut brown. The tuft of hair between the horns, on the inside of ear, and a narrow line along the back generally light. Horns rather short, waxey, with black tips. Nose black, with mealy-colored band surrounding nose. Switch, hoofs, and tongue black. Straight hind legs, wide thighs, and heavy quarters. The cows often weigh 1600 lbs., bulls 2000 lbs. Calves large, some weighing 110 lbs. when dropped. They mature fast, have healthy constitutions, yielding generous returns for whatever care, time, labor, or money is expended on them.

A cow shown at the Chicago Fat Stock Show in November, 1891, gave in three days 245 lbs. of milk, showing 9.32 lbs. of butter-fat by the Babcock test, yielding during one day of the test 3½ lbs. of fat, the largest amount of butter-fat ever shown at an official test of any cow of any breed up to that time. The cow Muotta calved about November 1, 1893, and in February, 1894, gave 67 lbs. of milk in one day.

The milk of Brown-Swiss cows has a sweet flavor which is very noticeable, and makes it very desirable for family use. With good farm care the cows give under favorable circumstances from 20 to 25 quarts of milk per day. They make the finest of beef and veal; when intended to be used for working oxen, they are easily broken and are fast walkers.

The cows are persistent milkers, with good teats; where used to produce grade animals they give the best of satisfaction, with the Swiss characteristics predominating. There are now about 8600 recorded animals in this country, located in almost every State, and some in Mexico.

YIELD OF MILK AND FAT FROM DAIRY COWS.

A good dairy cow should give at least 5000 pounds of milk during a whole period of lactation. As the quality of milk given by different cows varies greatly, however, as will be apparent from the tables given in the following, the yield of fat produced during a lactation period is a better standard to go by than that of the milk; three-fourths of a pound of fat per day for an average of 300 days may be considered a good yield (total 225 pounds). Many dairy farmers aim to have all mature cows in their herds produce a pound of fat, on the average, for every day in the year. To do this, a cow whose milk tests about 4 per cent. must give 25 pounds of milk a day (3 gallons) as an average for the whole year; a cow producing 3 per cent milk must give 33⅓ pounds of milk daily, and one producing 5 per cent milk must yield 20 pounds of milk daily, on the average, etc.

The flow of milk is usually at its highest shortly after calving, and then gradually decreases, the rate of decrease being determined by the inbred milking qualities of the cow and the system of feeding practised. The average decrease in milk yield for good dairy cows on good feed is from one half to three fourths of a pound per head per ten days. Where cows are not fed liberally and receive but little concentrated feed, the decrease will be more marked, and often exceed one pound of milk per head per ten days. The decrease is more marked during the latter stages of the period of lactation than in the earlier ones, and is also more marked in cows with poorly developed milking qualities than in good dairy cows. A cow is considered at her best when from five to seven years old; the constitutional strength of the animal, the system of feeding practised, and the general treatment given the cow will determine her period of usefulness.

The quality of the milk produced by individual cows generally remains fairly uniform through the greater portion of the lactation period, and is not permanently influenced in any marked manner by feed or any external conditions. During the last couple of months, when the

yield of milk is decreasing more rapidly than before, the quality is generally improved to some extent, the variation being, as a rule, within 1 per cent. Variations of several per cents of fat may sometimes occur from day to day, or milking to milking, in the milk from single cows; variations amounting to 1 per cent are common. Herd milk varies much less, the percentages of fat on subsequent days being as a rule within two tenths of one per cent, and only exceptionally near one per cent.

RESULTS OF TESTS OF DAIRY BREEDS Conducted by American Agricultural Experiment Stations.

Breed.	No. of Cows Included.	No. of Lactation Periods.	Average Yields per Lactation Period.		Average per cent. Fat.	Average Cost of		
			Milk.	Fat.		Food Eaten per Day.	Producing 100 lbs. Milk.	Producing 1 lb. Fat.
			lbs.	lbs.		cents	cents	cents
NEW YORK (GENEVA):								
Jersey	4	11	5045	282.1	5.60	12.4	90	16.1
Guernsey	4	6	5385	285.5	5.30	12.5	86	16.1
Holstein	4	4	7918	266.1	3.36	13.9	65	19.1
Ayrshire	4	12	6824	244.8	3.60	13.5	74	20.2
Short Horn	1	2	6055	269.0	4.44	12.7	78	17.2
Devon	3	5	3984	183.3	4.60	10.3	94	20.5
American Holderness	2	4	5721	213.1	3.73	12.2	76	20.1
MAINE:								
Jersey	2	4	5460	297.0	5.50	16.2	113.0	20.4
Holstein	2	3	8369	285.0	3.47	19.5	85.2	25.2
Ayrshire	2	4	6612	233.0	3.67	17.1	94.9	26.8
NEW JERSEY:								
Jersey	3	3	7695	376.3	4.89	16.1	87.1	17.9
Guernsey	4	4	7446	379.0	5.09	14.9	78.1	15.3
Holstein	3	3	8455	300.2	3.55	19.3	79.3	22.4
Ayrshire	4	4	7461	275.3	3.69	15.0	76.0	20.6
Short Horn	3	3	10457	396.3	3.79	15.4	79.2	20.6
Averages for all Breeds and Lactation Periods.								
Jersey	9	18	5579	301.1	5.40	13.9	94.7	17.4
Guernsey	8	10	6210	322.9	5.20	13.5	82.8	15.8
Holstein	9	10	8215	282.0	3.43	17.2	74.7	21.5
Ayrshire	10	20	6909	248.5	3.60	14.5	78.5	21.5
Short Horn	4	5	8696	345.4	3.97	14.3	78.7	19.4
Devon	3	5	3984	183.3	4.60	10.3	94.0	20.5
American Holderness	2	4	5721	213.1	3.73	11.2	76.0	20.1
Total	45	72						

The animals included in the foregoing breed tests rank on the average as follows:

1. *As to yield of fat:* Shorthorn, Guernsey, Jersey, Holstein, Ayrshire, American Holderness, Devon.

2. *As to cost of producing* 1 *lb. of fat:* Guernsey, Jersey, Shorthorn, American Holderness, Devon, Holstein and Ayrshire.

3. *As to yield of milk:* Shorthorn, Holstein, Ayrshire, Guernsey, American Holderness, Jersey, Devon.

4. *As to cost of producing* 100 *lbs. of milk:* Holstein, American Holderness, Ayrshire, Shorthorn, Guernsey, Devon, Jersey.

5. *As to cost of food:* Devon, American Holderness, Guernsey, Jersey, Shorthorn, Ayrshire, Holstein.

6. *As to richness of milk:* Jersey, Guernsey, Devon, Shorthorn, American Holderness, Ayrshire, Holstein.

RESULTS OF BREED TESTS CONDUCTED AT WORLD'S COLUMBIAN EXPOSITION, 1893.

A. Breed Test No. 1 (Cheese Test), May 10 to 25.

	Milk Produced, lbs.	Fat Produced, lbs.	Cheese, lbs.	Price of Cheese per lb., cents.	Cost of Feed.	Net Gain.
25 Jerseys...... ...	13,296.4	601 91	1451.8	13.36	$98.14	$119.82
25 Guernseys	10,938.6	488.42	1130.6	11.95	76.25	88.30
25 Short-horns.....	12,186.9	436.60	1077.6	13 00	99.36	81.36

B. Breed Test No. 2 (Ninety-day Butter Test), June 1 to Aug. 29.

			Butter credited	Price of Butter.		
25 Jerseys..........	73,488.8	3516.08	4274.01	$1747.37	$587.50	$1323.81
25 Guernseys	61,781.7	2784.56	3360.43	1355.44	484.14	997.64
24 Short-horns......	66,263.2	2409.97	2890.87	1171.77	501.79	910.12

AVERAGES PER DAY PER COW.

			Fat, per cent.	Cost of Food.
Jerseys	32.7	1.56	4.78	26.1 cts.
Guernseys	27.5	1.24	4.51	21.5 "
Short-horns..	30.7	1.12	3.64	23.2 "

C. Breed Test No. 3 (Thirty-day Butter Test), Aug. 29 to Sept. 28.

			Butter credited	Price of Butter.		
15 Jerseys..........	13,921.9	685.81	837.21	$385.59	$111.24	$274.13
15 Guernseys	13,518.4	597.96	724.17	329.77	92.77	237.00
15 Short-horns.....	15,618.3	555.43	662.67	303.69	104.55	198.89

D. Breed Test No. 4 (Heifer Test), Sept 30 to Oct. 20.

7 Jerseys.	3356.6	155.38	194.23	$77.69	$34.44	$56.28
6 Short-horns......	2581.0	97.89	122.36	48.95	23.53	47.42

RESULTS OF "COW DEMONSTRATION" AT LOUISIANA PURCHASE EXPOSITION, ST. LOUIS, 1904. (Farrington.)

	Brown-Swiss.	Holsteins.	Jerseys.	Shorthorns.
Average data for number of cows	5	15	25	28
Milk per day (av. for 120 days) lbs.	44.2	53.4	41.5	34.6
Per cent fat in milk	3.62	3.43	4.70	3.80
Butter-fat per day, lbs.	1.596	1.832	1.936	1.277
Solids not fat per day, lbs.	3.92	4.24	3.63	2.98
Feed cost per qt. of milk, cts.	1.24	1.07	1.16	1.32
" " " lb butter, cts.	14.7	13.5	10.5	15.3
Data for best cows:				
Milk per day, lbs.	51.0	67.5	48.4	43.4
Per cent fat in milk	3.4	3.5	4.8	4.0
Butter-fat per day, lbs.	1.748	2.355	2.334	1.737
Solids not fat per day lbs.	4.36	5.17	4.36	3.72

HIGHEST RECORD FOR YIELD OF BUTTER-FAT

During Twenty-four Hours Made by any Cow in a Public Test.

At a Fair.	At Home.
Briens, Brown-Swiss, 11 years old, weighing 1395 lbs. Average daily yield of milk. . . . 81.7 lbs. Average daily yield of fat. . . . 3.11 " Average per cent of fat in day's milk. . . . 3.81 (American Dairy Show, Chicago, 1891; 3-day test.)	*DeKol Witkop Wayne 2d*, No. 58,709, H.-F. H. B. Yield of milk. . . . 70.7 lbs. " " fat . . . . 4.77 " Average per cent of fat in day's milk . . 6.75 (March 1–2, 1908. 7-day test, Feb. 29–Mar. 7, 1908, conducted by the Cornell Univ. (N. Y.) Experiment Station; total yield for week, 484.5 lbs. milk and 23.095 lbs. fat; average per cent of fat in milk, 4.77); test commenced 6 days from last calving; age of cow, 6 years 10 months).

OFFICIAL RECORDS FOR MILK AND BUTTER-FAT PRODUCTION.

Breed.	Year.	Thirty Days.	Seven Days.	Twenty-four Hours.
(A) Milk Records.				
Ayrshire......	Auchenbrain Brown Kate 4th, 23,022.0 lbs.	Same, 2322.9	....	....
Brown Swiss..	College Bravura 2d, 2577 19,460.6 lbs.	....	....	....
Guernsey.....	May Rilma 22,761 19,673.0 lbs.	Murne Cowan 19,597 2361.5 lbs.	Same. 564.8 lbs.	Same. 82.1 lbs.
Holstein......	Pietertje 2d, 3273 H, 30,318.5 lbs.	Riverside Sadie De Kol Burke, 70,708 3707.2 lbs.	Same, 902.1 lbs.	Margie Newman, 76.312 136.5 lbs.
Jersey........	Eminent's Bess, 209,719 18,782.9 lbs.	Hector's Fairy Belle, 179,909 1641.9 lbs.	Jacoba Irene, 146,443 444.1 lbs.	....
Shorthorn....	Rose of Glenside, 18,075.2 lbs.	Daisy Oxford 1788 lbs.	Rose of Glenside. 434.1 lbs.	Same, 62.8 lbs.
Red Polled...	Pear, 24,888 13,160.1 lbs.	....	Popsey 3d, U–43, 9689 393.25 lbs.	Hera N–6, 3505 63.5 lbs.
(B) Butter-fat Records.				
Ayrshire......	Auchenbrain Brown Kate 4th, 917.60 lbs.	Gerranton Dora 2d, 23,853 102.04 lbs.	Same. 23.03 lbs.*	Same, 3.29 lbs.*
Brown Swiss..	College Bravura 2d, 2577 798.16 lbs.	....	....	....
Guernsey.....	May Rilma, 22,761 1073.41 lbs.	Same, 103.03 lbs.	Same, 24.4 lbs.†	Golden Elsie 2d, 33,422 3.70 lbs.
Holstein......	Banostine Belle de Kol, 90,441 1058.34 lbs.	K. P. Pontiac Lass, 106,812 137.19 lbs.	Same, 35.34 lbs.	....
Jersey........	Sophie 19th of Hood Farm, 189,748 999.14 lbs.	Hector's Fairy Belle, 179,909 83.63 lbs.	Sophie 19th of Hood Farm, 189,748 25.44 lbs.	....
Shorthorn....	Ruth 3d, 20,440 706.63 lbs.	Rose of Glenside, 63.45 lbs.	....	....
Red Polled...	Pear, 24,888 603.66 lbs.	Same, 68.85 lbs.	Nina, 26,710 17.80 lbs.	Hera, N–6, 3505 3.86 lbs.

* Aver. production calculated from 30-day record.
† Tied with Murne Cowan, 19,597.

RESULTS OF ENGLISH MILKING TRIALS.

(Averages of breed-tests conducted at the annual dairy shows of the British Dairy Farmers' Assoc., 1879–98, inclusive.)

Total No. of Animals.	Breed.	Average Yield of Milk per Day.	Total Solids.		Fat.		Solids not Fat, Per Cent.	Live Weight.
			Yield per Day.	Per Cent.	Yield per Day.	Per Cent.		
		lbs.	lbs.		lbs.			lbs.
236	Shorthorns......	45.4	5.77	12.72	1.70	3.75	8.97	1405 (117)*
272	Jerseys...........	28.9	4.18	14.46	1.44	4.98	9.48	856 (157)
98	Guernseys........	30.6	4.13	13.50	1.41	4.61	8.89	1026 (49)
10	Holsteins (Dutch)	45.2	5.53	12.25	1.54	3.41	8.84	1383 (3)
32	Ayrshires	42.2	5.61	13.29	1.77	4.19	9.10	1046 (21)
2	Devons..........	30.1	4.32	14.34	1.48	4.90	9.44	....
35	Red Polls	41.9	5.26	12.55	1.54	3.68	8.87	1162 (32)
1	Welsh	46.0	5.86	12.74	1.91	4.16	8.58	....
1	Aberdeen Angus.	60.3	8.29	13.74	3.01	4.99	8.75	....
44	Kerries and Dexter Kerries.....	27.1	3.62	13.36	1.18	4.36	9.00	787 (41)
54	Crosses..........	53.1	7.07	13.31	2.07	3.90	9.41	1230 (38)
785								

* Average for 117 animals.

REQUIREMENTS FOR ADMISSION TO ADVANCED REGISTERS OF BREED ASSOCIATIONS, 1913.

Breed.	Based on	Requirements in Pounds at					Pounds Increase per Day over Minimum.
		2 yrs.	3 yrs.	4 yrs.	5 yrs.	6 yrs.	
Ayrshire	Yrs. milk	6000	6500	7500	8500	*	1.37 and 2.74
	" fat	214.3	236.0	279.0	322.0	*	.06 and .12
Brown-Swiss	Yrs. milk	6000†	6430	7288	8146	9000	2.35
	" fat	222.0	238.5	271.3	304.2	337.0	.09
Guernsey..	Yrs. fat	250.5	287.0	323.5	360.0	*	.10
Holstein...	7 da. fat	7.2	8.8	10.4	12.0	*	.00439
Jersey.....	7 da. fat	12.0	12.0	12.0	12.0	*	
	Yrs. fat	250.5	287.0	323.5	360.0	*	.10

* No increase.
† At 2.5 years.

AVERAGE PER CENT OF FAT AND PRODUCTION OF MILK AND BUTTER FAT BY PURE-BRED DAIRY COWS, PER BREED.*

Breed.	No. of Cows.	Per Cent Fat.	No. of Cows.	Average Daily Milk Yield.	Calculated Average Daily Yield of Fat.
				lbs.	lbs.
Jersey	491	4.98	425	27.3	1.36
Guernsey	191	4.77	151	29.7	1.42
Holstein-Friesian	679	3.28	503	48.8	1.60
Shorthorn	370	3.73	275	43.5	1.62
Ayrshire	108	3.84	50	37.0	1.42
Red Polled	50	3.73	50	37.3	1.39
Brown Swiss	20	3.78	14	37.3	1.41
Devon	50	4.57	27	13.2	.60
Dutch Belted	5	3.40	5	27.2	.92
Polled Jersey	5	4.66	5	22.9	1.07
French Canadian	5	3.99	5	27.0	1.08

* See Woll, On the Average Composition of Milk of Pure-bred Cows of Different Breeds (Wis. Exp. Sta., Report 1901).

AVERAGE PERCENTAGE COMPOSITION OF MILK FROM DIFFERENT BREEDS. (König.)

Name of Breed.	No. of Analyses.	Water.	Fat.	Casein and Albumen.	Milk Sugar.	Ash.	Total Solids.	Solids not Fat.
Steyer (Austrian)	12	86.90	4.17	3.24	4.96	.73	13.10	8.93
Simmenthal (Swiss)	6	87.26	3.79	2.64	5.81	.70	12.74	8.95
Tillerthal (Tyrolean)	22	87.43	3.70	3.07	5.10	.70	12.57	8.87
Vorarlberg (Austrian)	19	87.38	3.54	2.91	5.40	.77	12.62	9.08
Algau (Bavarian)	4	87.88	3.20	3.22	5.13	.57	12.12	8.92
Bohemian	2	86.00	5.06	3.67	4.63	.64	14.00	8.94
Holstein	24	88.04	3.25	3.99	4.16	.56	11.96	8.71
Oldenburg (German)	18	87.95	3.38	3.10	4.81	.76	12.05	8.67
Angler (Danish)	10	88.15	3.12	....	....	...	11.85	8.73
Short-horn	67	87.20	3.47	3.21	5.43	.69	12.80	9.33
Devon	20	86.57	4.44	..	....	.64	13.43	8.99
Ayrshire	43	86.93	3.58	3.42	5.43	.64	13.07	9.49
Jersey	31	85.90	4.32	3.34	5.70	.74	14.10	9.78
Guernsey	26	85.39	5.11	3.98	4.38	1.14 (?)	14.61	9.50
French	12	87.20	3.90	3.07	5.06	.77	12.80	8.90
Scandinavian	4	88.00	3.51	2.76	4.97	.76	12.00	8.49

METHODS OF JUDGING THE VALUE OF DAIRY COWS.

The *British Dairy Farmers' Association*, which has conducted tests of dairy cows at their annual fair for the last twenty years, has during late years scored the dairy cows competing for premiums according to the following scale:

1 point for each pound of milk;
20 points for each pound of fat;
4 points for each pound of solids not fat.
1 point for each ten days in milk after the first twenty days (limit 200 days).
10 points are deducted from the total score for each per cent. of fat below three per cent in the milk.

The cows entered in the test are separated into four classes, according to the breed, each class being divided into two divisions, cows and heifers. The classes are Shorthorns, Jerseys, Guernseys, and cross-breeds.

Other associations abroad or in this country have not generally followed any definite plan from year to year in awarding premiums to dairy cows at fairs, the awards having been given to cows producing most milk, or richest milk, or most butter-fat, or most solids, during the test, which may have lasted one to three days. At the Vermont State Fair, 1889, the following points were given: For each 20 days since calving, 1 point; for each 10 days of gestation, 1 point; for each 2 oz. of total solids in 24 hours' milk, 1 point; for each oz. of butter-fat in 24 hours' milk, 2 points; for each 2 oz. of salted butter from 24 hours' milk, 1 point. In the milking trials conducted by the Royal Agricultural Society of England, the size of the cows has been considered, the cows being, as a rule, separated into two classes, viz., over and under 1100 lbs. live weight.

From the best information at hand at the present, the system of awards adopted by the British Dairy Farmers' Association, and given above, must be considered the most perfect and the most just to all concerned Its main shortcomings lie, as it would seem, in its not considering the food eaten by each animal during the test, and in the fact that the test is made at the fair, and not at home under

every-day conditions and in surroundings familiar to the animals. The former objection would be removed by taking into account the dry matter in the food eaten, as shown by chemical analysis. (See also Wisconsin Exp. Station, Research bull. No. 26, pp. 78–80.)

BUYING AND SELLING COWS BY TESTS OF THEIR MILK. (Emery.)

The money value of a cow may be estimated by multiplying the number of gallons of milk which the cow gives by 12, adding to or subtracting from this product one dollar for every one fourth per cent of fat in the milk above or below 3.5 per cent.

$$\text{Value} = \frac{\text{pounds of milk per day}}{8\frac{1}{2}} \times 12 + 4\,(\text{per cent fat} - 3.5).$$

(See Bull. No. 113, N. C. Exp. Station.)

FIFTY DAIRY RULES.

(U. S. Department of Agriculture.)

The Owner and his Helpers.—1. Read current dairy literature and keep posted on new ideas.

2. Observe and enforce the utmost cleanliness about the cattle, their attendants, the stable, the dairy, and all utensils.

3. A person suffering from any disease, or who has been exposed to a contagious disease, must remain away from the cows and the milk.

The Stable.—4. Keep dairy cattle in a room or building by themselves. It is preferable to have no cellar below and no storage loft above.

5. Stables should be well ventilated, lighted, and drained; should have tight floors and walls and be plainly constructed.

6. Never use musty or dirty litter.

7. Allow no strong-smelling material in the stable for any length of time. Store the manure under cover outside the

cow-stable, and remove it to a distance as often as practicable.

8. Whitewash the stable once or twice a year; use land plaster in the manure-gutters daily.

9. Use no dry, dusty feed just previous to milking; if fodder is dusty, sprinkle it before it is fed.

10. Clean and thoroughly air the stable before milking; in hot weather sprinkle the floor.

11. Keep the stable and dairy-room in good condition, and then insist that the dairy, factory, or place where the milk goes be kept equally well.

The Cows.—12. Have the herd examined at least twice a year by a skilled veterinarian.

13. Promptly remove from the herd any animal suspected of being in bad health, and reject her milk. Never add an animal to the herd until certain it is free from disease, especially tuberculosis.

14. Do not move cows faster than a comfortable walk while on the way to place of milking or feeding.

15. Never allow the cows to be excited by hard driving, abuse, loud talking, or unnecessary disturbance; do not expose them to cold or storms.

16. Do not change the feed suddenly.

17. Feed liberally, and use only fresh, palatable feedstuffs; in no case should decomposed or moldy material be used.

18. Provide water in abundance, easy of access, and always pure; fresh, but not too cold.

19. Salt should always be accessible.

20. Do not allow any strong-flavored food, like garlic, cabbage, and turnips, to be eaten, except immediately after milking.

21. Clean the entire body of the cow daily. If hair in the region of the udder is not easily kept clean it should be clipped.

22. Do not use the milk within twenty days before calving, nor for three to five days afterwards.

Milking.—23. The milker should be clean in all respects; he should not use tobacco; he should wash and dry his hands just before milking.

24. The milker should wear a clean outer garment, used only when milking, and kept in a clean place at other times.

25. Brush the udder and surrounding parts just before milking, and wipe them with a clean, damp cloth or sponge.

26. Milk quietly, quickly, cleanly, and thoroughly. Cows do not like unnecessary noise or delay. Commence milking at exactly the same hour every morning and evening, and milk the cows in the same order.

27. Throw away (but not on the floor, better in the gutter) the first few streams from each teat; this milk is very watery and of little value, but it may injure the rest.

28. If in any milking a part of the milk is bloody, stringy or unnatural in appearance, the whole mess should be rejected.

29. Milk with dry hands; never allow the hands to come in contact with the milk.

30. Do not allow dogs, cats, or loafers to be around at milking-time.

31. If any accident occurs by which a pail full or partly full of milk becomes dirty, do not try to remedy this by straining, but reject all this milk and rinse the pail.

32. Weigh and record the milk given by each cow, and take a sample morning and night, at least once a week, for testing by the fat test.

Care of Milk.—33. Remove the milk of every cow at once from the stable to a clean, dry room, where the air is pure and sweet. Do not allow cans to remain in stables while they are being filled.

34. Strain the milk through a metal gauze and a flannel cloth or layer of cotton as soon as it is drawn.

35. Aerate and cool the milk as soon as strained. If an apparatus for airing and cooling at the same time is not at hand, the milk should be aired first. This must be done in pure air, and it should then be cooled to 45 degrees if the milk is for shipment, or to 60 degrees if for home use or delivery to a factory.

36. Never close a can containing warm milk which has not been aerated.

37. If cover is left off the can, a piece of cloth or mosquito-netting should be used to keep out insects.

38. If milk is stored, it should be held in tanks of fresh, cold water (renewed daily), in a clean, dry, cold room. Unless it is desired to remove cream, it should be stirred with a tin stirrer often enough to prevent forming a thick cream layer.

39. Keep the night milk under shelter so rain cannot get into the cans. In warm weather hold it in a tank of fresh cold water.

40. Never mix fresh warm milk with that which has been cooled.

41. Do not allow the milk to freeze.

42. Under no circumstances should anything be added to milk to prevent its souring. Cleanliness and cold are the only preventives needed.

43. All milk should be in good condition when delivered. This may make it necessary to deliver twice a day during the hottest weather.

44. When cans are hauled far they should be full, and carried in a spring wagon.

45. In hot weather cover the cans, when moved in a wagon, with a clean wet blanket or canvas.

The Utensils.—46. Milk-utensils for farm use should be made of metal and have all joints smoothly soldered. Never allow them to become rusty or rough inside.

47. Do not haul waste products back to the farm in the same cans used for delivering milk. When this is unavoidable, insist that the skim-milk or whey-tank be kept clean.

48. Cans used for the return of skim-milk or whey should be emptied and cleaned as soon as they arrive at the farm.

49. Clean all dairy utensils by first thoroughly rinsing them in warm water; then clean inside and out with a brush and hot water in which a cleaning material is dissolved; then rinse and lastly sterilize by boiling water or steam. Use pure water only.

50. After cleaning, keep utensils, inverted, in pure air, and sun if possible, until wanted for use.

II. MILK.

PERCENTAGE COMPOSITION OF VARIOUS KINDS OF MILK. (König.)

	No. of Analyses.	Water.	Fat.	Casein and Albumen.	Milk Sugar.	Ash.	Specific Gravity.
Human........	107	87.41	3.78	2.29	6.21	.31	1.0270
Mare	50	90.78	1.21	1.99	5.67	.35	1.0347
Buffalo..........	8	82.25	7.51	5.05	4.44	.75	1.0330
Ass..............	7	89.64	1.64	2.22	5.99	.51	1.0345
Cow	793	87.17	3.69	3.55	4.88	.71	1.0316
Ewe.............	32	80.82	6.86	6.52	4.91	.89	1.0341
Goat.............	38	85.71	4.78	4.29	4.46	.76	1.0328
Reindeer*.......	2	67.20	17.10	11.39	2.82	1.49	1.0477
Sow..............	20	82.51	5.78	6.34	4.37	1.00	1.0385
Bitch......... ..	28	75.44	9.57	11.17	3.09	.73	1.035
Elephant..	3	79.30	9.10	2.51	8.59	.50	1.0313
Hippopotamus..	1	90.43	4.51	....	4.40	.11	......
Camel..........	3	86.57	3.07	4.00	5.59	.77	1.042
Llama.	3	86.55	3.15	3.90	5.60	.80	1.034

* Werenskiold.

AVERAGE ANALYSES OF AMERICAN SAMPLES OF DAIRY PRODUCTS. (Goessmann.)

	Whole Milk.	Skim-milk.	Butter-milk.	Cream from Cooley Creamer.	Butter.
No. of samples.......	1889	348	31	197	25
Water	86.53	90.52	91.67	73.90	10.89
Fat	4.14	.32	.27	17.66	83.95
Casein and albumen..	3.20	3.53	2.79	......	.42*
Milk-sugar...........	5.43*	4.83*	4.47*	......	......
Ash.............. ..	.70	.80	.80	.62	4.74
	100.00	100.00	100.00	......	100.00
Total solids..........	13.47	9.48	8.33	26.10	89.11
Solids not fat........	9.33	9.16	8.06	8.44	5.16

* By difference.

AVERAGE COMPOSITION OF COWS' MILK, WITH VARIATIONS. (KÖNIG.)

	Average of 705 Analyses (largely European).	Minimum.	Maximum.
Water	87.27 per cent	80.32 per cent	90.22 per cent
Fat	3.68 " "	1.48 " "	6.47 " "
Casein	2.88 } 3.55 p. c.	1.79 } 2.07 p. c.	6.29 } 6.40 p.c.
Albumen	.51	.25	1.44
Milk-sugar	4.94 per cent	3.23 per cent	6.48 per cent
Ash	.72 " "	.50 " "	1.45 " "
	100.00		
Total solids	12.73 per cent	9.31 per cent	19.68 per cent
Solids not fat	9.14 " "	....	....
Specific gravity	1.0313	1.0264	1.0368

COMPOSITION OF MORNING AND EVENING MILK, AND OF MORNING, NOON, AND EVENING MILK. (KÖNIG.)

	No. of Analyses.	Water.	Fat.	Casein and Albumens	Milk-sugar.	Ash.
Morning milk	139	87.70	3.38	3.61	4.64	.67
Evening "	139	87.29	3.58	3.64	4.81	.69
Morning milk	52	88.28	3.05	3.24	4.69	.74
Noon "	52	87.43	3.81	3.26	4.75	.75
Evening "	52	87.60	3.59	3.20	4.87	.74

COMPOSITION OF DIFFERENT PARTS OF THE SAME MILKINGS. (KÖNIG.)

	No. of Analyses.	Water.	Fat.	Casein and Albumen	Milk-sugar.	Ash.	Total Solids.
		Per ct.	Per ct.	Per ct.	Per ct.	P'r ct.	Per ct.
First portion	7	89.84	1.78	2.88	4.81	.69	10.16
Second "	7	88.12	3.34	2.94	4.92	.68	11.88
Third "	6	86.29	4.52	2.59	5.88	.72	13.71

CALCULATION OF COMPONENTS OF COWS' MILK.

According to Vieth the components of the non-fatty milk solids will stand in the ratio to one another of about

	10	:	13	:	2
for	casein and albumen	:	milk sugar	:	ash.

If the solids not fat in a sample of milk are 9 per cent, the per cent of casein and albumen in the same will be approximately $\frac{9}{25} \times 10 = 3.60$ per cent; sugar, $\frac{9}{25} \times 13 = 4.68$ per cent; and ash, $\frac{9}{25} \times 2 = .72$ per cent.

TABLE SHOWING RELATION OF FAT TO CASEIN AND OTHER SOLIDS. (Cooke.)

Total Solids.	Fat.	Casein and Albumen.	Milk-sugar and Ash.	Solids not Fat.
Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
11.00	3.07	2.92	5.01	7.93
11.50	3.29	3.00	5.21	8.21
12.00	3.50	3.07	5.43	8.50
12.50	3.75	3.19	5.56	8.75
13.00	3.99	3.30	5.71	9.01
13.50	4.34	3.44	5.72	9.16
14.00	4.68	3.57	5.75	9.32
14.50	4.93	3.79	5.68	9.47
15.00	5.38	4.00	5.62	9.62
15.50	5.69	4.15	5.66	9.81
16.00	6.00	4.30	5.70	10.00

This table, which is summarized from the analyses of about 2400 American samples of milk, shows that while the percentage of fat varies from 3.07 to 6 per cent, or nearly three per cent, that of casein varies only from 2.92 to 4.3- per cent, less than one and one half per cent. It also shows that a higher percentage of fat is always accompanied by a higher percentage of casein. Milk sugar and ash increase but little as the milk grows richer.

FERTILIZING INGREDIENTS IN DAIRY PRODUCTS.

Average of American Analyses. (Cooke and Hills.)

	Nitrogen.	Phosphoric Acid.	Potash.	Value per Ton.
Whole milk	.53%	.19%	.175%	$ 2.17
Skim-milk	.56	.20	.185	2.31
Cream	.40	.15	.130	.66
Buttermilk	.48	.17	.158	1.98
Whey	.15	.14	.181	.84
Butter	.12	.04	.036	.49
Cheese	3.93	.60	.120	14.19

COMPOSITION OF COLOSTRUM. (König.)

	No. of Analyses.	Water.	Casein.	Albumen.	Butter-fat.	Milk-sugar.	Ash.
Ewe	11	77.9	4.9	3.4	8.3	4.6	.9
Goat	1	64.1	5.2	3.2	24.5	......	3.0
Sow	1	70.1	7.6	8.0	9.5	3.9	.9
Cow	42	74.6	4.0	13.6	3.6	2.7	1.6

COMPOSITION OF ASH OF COWS' MILK AND COLOSTRUM.

	Cows' Milk.	Colostrum.
Total ash	.7 per cent	1.6 per cent
100 parts of ash will contain:		
Potash	24 "	7 "
Soda	6 "	6 "
Lime	23 "	35 "
Phosphoric acid	28 "	41 "
Chlorin	13 "	13 "

A CHAPTER ON MILK TESTING.*

The Babcock milk test is the quick and simple method of determining the fat content of milk which has been most generally adopted in this country. The test was invented by Dr. S. M. Babcock, of Wisconsin Agricultural Experiment Station, and was first published in July, 1890. The following is an outline of the method:

A known quantity of milk (17.6 cubic centimeters, or about $\frac{5}{8}$ of an ounce) is pipetted off into a graduated test-bottle; 17.5 cc. of commercial sulfuric acid, of a specific gravity of 1.82 to 1.83, is then measured out by means of a graduated cylinder or an automatic pipette, and added to the milk. The two fluids are mixed, and when the curd is dissolved, the test-bottles are placed in a centrifugal machine and whirled for 4 minutes at a rate of 800–1200 revolutions per minute, the small hand-machines on the market requiring the higher number of revolutions. Boiling hot water is then filled into the bottles, by which means the liquid fat is brought into the narrow graduated neck of the bottles; after an additional whirling of the bottles for a minute, the length of the column of fat is read off in per cent.

The whole process of testing a sample of milk according to this method will take less than a quarter of an hour when a little skill in manipulation has been reached.

The various dealers in dairy implements have placed Babcock machines on the market in sizes from 4- to 60-bottle machines, and supply the necessary outfit, as test-bottles, pipettes, graduates, and sulfuric acid. There are at present three different types of machines: hand-machines (friction or cog-wheel machines; the latter ones are to be preferred, and have now practically replaced the friction machines), steam turbine, and belt-power machines. The Facile, Twentieth Century, and Agos Babcock testers are

* The subject of milk testing is treated exhaustively, and detailed directions for using the Babcock test are given in *Farrington-Woll*, Testing Milk and its Products, Mendota Book Co., Madison, Wis., 21st Edition, 1912.

the best hand-machines on the market at the present time. Steam turbine machines are to be recommended for factory use; they should always be provided with a speed indicator so as to avoid too slow or too rapid whirling; several accidents have happened where the bottles were unable to stand the pressure caused by too rapid whirling. In many turbine testers the bottles are heated to about 200° F., and the bottles should in case of such machines be left to cool to about 150° F. before results are read off. Readings taken at temperatures higher than this come too high, viz., in extreme cases, from .2 to .3 per cent too high in case of new milk, and toward one per cent too high in case of cream. (See Wis. Exp. Sta. Report for 1889–1900.)

In Sharples' Russian Babcock Tester (a steam-turbine test manufactured by the Dairy Specialty Co., West Chester, Pa.) the bottles used can be filled with hot water while the machine is in motion; the test bottles used are arranged for half the usual quantity of milk.

Points to be watched in making tests by the Babcock method:

The strength of the acid used is very important; its specific gravity should not go below 1.82 or above 1.84; if the acid is somewhat too strong less may be taken, and a little more if it is rather weak. It is, however, not possible to make a satisfactory test with acid of a specific gravity below 1.82. Keep the acid bottle corked when not in use, as the acid will otherwise take up moisture from the air.

In testing separator skim-milk use a somewhat larger quantity of acid than usual, and whirl 5 to 6 minutes; this will insure a nearly perfect separation of all the fat present in such milks. The two-necked so-called Ohlsson bottles are recommended for testing separator skim-milk; the results should be increased by .05 per cent with these as with other test bottles, in testing separator skim-milk.

The centrifugal machine should run at a rate of about 800 to 1000 revolutions per minute; if its diameter is small, whirl 1000 or 1200.

Soft or rain-water is used in filling up the bottle after

boiling, or hard water may be used if some drops of sulfuric acid have been added to it before the boiling.

In adding the acid the bottle should be held at an angle, so as to cause the acid to follow the inside of the wall. Mix the milk and acid at once, or within a short time, and proceed with the test without delay.

Read off results before the fat begins to crystallize. If many tests are made at a time, and the room is cold, place the bottles in a pail with water of 140–150° and keep them warm until results are recorded.

Application of Babcock's Test.—The method may be used to advantage in determining the fat content of full milk, skim-milk, buttermilk, whey, cream, condensed milk, and cheese. It cannot be recommended for the estimation of fat in butter, since the error of analysis in this case is too large. In testing separator skim-milk, buttermilk, and whey by this method, no reading should be taken lower than one-tenth of one per cent. If only a small drop or two of liquid fat appears in the neck of the bottles after finished whirling the result is therefore to be put down as .1 per cent, instead of estimates of .05, and still lower, which are sometimes made. (See Bull. No. 52, Wis. Experiment Station.)

Lactometer.—The Quevenne lactometer, with the thermometer tube extending into the narrow stem of the instrument, is recommended for dairy work. In the N. Y. Board of Health lactometer, often used, the scale is divided into 120 divisions, the mark 100 corresponding to a specific gravity of 1.029, and that of 120 to a specific gravity of 1.0348. These lactometer degrees can be converted into Quevenne lactometer degrees by multiplying by .29. The following table gives the readings of the two scales between 60 and 120 on the Board of Health lactometer:

TABLE SHOWING THE QUEVENNE LACTOMETER DEGREES CORRESPONDING TO THE SCALE OF LACTOMETERS GRADUATED FROM 60 TO 120.

N. Y. Bd. of Health Scale.	Quevenne Scale.	N. Y. Bd. of Health Scale.	Quevenne Scale.	N. Y. Bd. of Health Scale.	Quevenne Scale.
60	17.4	81	23.5	101	29.3
61	17.7	82	23.8	102	29.6
62	18	83	24.1	103	29.9
63	18.3	84	24.4	104	30.2
64	18.6	85	24.6	105	30.5
65	18.8	86	24.9	106	30.7
66	19.1	87	25.2	107	31
67	19.4	88	25.5	108	31.3
68	19.7	89	25.8	109	31.6
69	20	90	26.1	110	31.9
70	29.3	91	26.4	111	32.2
71	20.6	92	26.7	112	32.5
72	20.9	93	27	113	32.8
73	21.2	94	27.3	114	33.1
74	21.5	95	27.6	115	33.4
75	21.7	96	27.8	116	33.6
76	22	97	28.1	117	33 9
77	22.3	98	28.4	118	34.2
78	22.6	99	28.7	119	34.5
79	22.9	100	29	120	34.8
80	23.2				

In taking the specific gravity of milk by means of a lactometer, the temperature of the milk should not vary more than 10° either way from 60° F. The following tables show the proper corrections for temperature to be made, if the milk was either warmer or colder than 60° F., the temperature to which the specific gravities of all liquids are usually referred.

In practical work sufficiently accurate corrections for temperature may generally be made by adding .1 to the lactometer reading for each degree above 60° F., and by subtracting .1 for each degree below 60°; e.g., if the reading at 64° is 29.5, it will be about $29.5 + .4 = 29.9$ at 60°; if 34.0 at 52°, it will be about $34.0 - .8 = 33.2$ at 60°. By reference to the following table we find it is more correctly 33.0.

TEMPERATURE CORRECTION TABLE FOR SPECIFIC GRAVITY OF MILK. (Vieth.)

Lactometer Reading.	Temperature of Milk (in Degrees Fahrenheit).															
	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
20	19.0	19.0	19.1	19.1	19.2	19.2	19.3	19.4	19.4	19.5	19.6	19.7	19.8	19.9	19.9	20.0
21	19.9	20.0	20.0	20.1	20.2	20.2	20.3	20.3	20.4	20.5	20.6	20.7	20.8	20.9	20.9	21.0
22	20.9	21.0	21.0	21.1	21.2	21.2	21.3	21.3	21.4	21.5	21.6	21.7	21.8	21.9	21.9	22.0
23	21.9	22.0	22.0	22.1	22.2	22.2	22.3	22.3	22.4	22.5	22.6	22.7	22.8	22.8	22.9	23.0
24	22.9	22.9	23.0	23.1	23.2	23.2	23.3	23.3	23.4	23.5	23.6	23.6	23.7	23.8	23.9	24.0
25	23.8	23.9	24.0	24.0	24.1	24.1	24.2	24.3	24.4	24.5	24.6	24.6	24.7	24.8	24.9	25.0
26	24.8	24.9	24.9	25.0	25.1	25.1	25.2	25.2	25.3	25.4	25.5	25.6	25.7	25.8	25.9	26.0
27	25.8	25.9	25.9	26.0	26.1	26.1	26.2	26.2	26.3	26.4	26.5	26.6	26.7	26.8	26.9	27.0
28	26.7	26.8	26.8	26.9	27.0	27.0	27.1	27.2	27.3	27.4	27.5	27.6	27.7	27.8	27.9	28.0
29	27.7	27.8	27.8	27.9	28.0	28.0	28.1	28.2	28.3	28.4	28.5	28.6	28.7	28.8	28.9	29.0
30	28.6	28.7	28.7	28.8	28.9	29.0	29.1	29.1	29.2	29.3	29.4	29.6	29.7	29.8	29.9	30.0
31	29.5	29.6	29.6	29.7	29.8	29.9	30.0	30.1	30.2	30.3	30.4	30.5	30.6	30.8	30.9	31.0
32	30.4	30.5	30.5	30.6	30.7	30.9	31.0	31.1	31.2	31.3	31.4	31.5	31.6	31.7	31.9	32.0
33	31.3	31.4	31.4	31.5	31.6	31.8	31.9	32.0	32.1	32.3	32.4	32.5	32.6	32.7	32.9	33.0
34	32.2	32.3	32.3	32.4	32.5	32.7	32.9	33.0	33.1	33.2	33.3	33.5	33.6	33.7	33.9	34.0
35	33.0	33.1	33.2	33.4	33.5	33.6	33.8	33.9	34.0	34.2	34.3	34.5	34.6	34.7	34.9	35.0

TEMPERATURE CORRECTION TABLE FOR SPECIFIC GRAVITY OF MILK.—(*Continued.*)

Lactometer Reading.	Temperature of Milk (in Degrees Fahrenheit).														
	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
20	20.1	20.2	20.2	20.3	20.4	20.5	20.6	20.7	20.9	21.0	21.1	21.2	21.3	21.5	21.6
21	21.1	21.2	21.3	21.4	21.5	21.6	21.7	21.8	22.0	22.1	22.2	22.3	22.4	22.5	22.6
22	22.1	22.2	22.3	22.4	22.5	22.6	22.7	22.8	23.0	23.1	23.2	23.3	23.4	23.5	23.7
23	23.1	23.2	23.3	23.4	23.5	23.6	23.7	23.8	24.0	24.1	24.2	24.3	24.4	24.6	24.7
24	24.1	24.2	24.3	24.4	24.5	24.6	24.7	24.9	25.0	25.1	25.2	25.3	25.5	25.6	25.7
25	25.1	25.2	25.3	25.4	25.5	25.6	25.7	25.9	26.0	26.1	26.2	26.4	26.6	26.6	26.8
26	26.1	26.2	26.3	26.5	26.6	26.7	26.8	27.0	27.1	27.2	27.3	27.4	27.6	27.7	27.8
27	27.1	27.3	27.4	27.5	27.6	27.7	27.8	28.0	28.1	28.2	28.3	28.4	28.6	28.7	28.9
28	28.1	28.3	28.4	28.5	28.6	28.7	28.8	29.0	29.1	29.2	29.4	29.5	29.7	29.8	29.9
29	29.1	29.3	29.4	29.5	29.6	29.7	29.9	30.1	30.2	30.3	30.4	30.5	30.7	30.9	31.0
30	30.1	30.3	30.4	30.5	30.7	30.8	30.9	31.1	31.2	31.3	31.5	31.6	31.8	31.9	32.1
31	31.2	31.3	31.4	31.5	31.7	31.8	31.9	32.1	32.2	32.4	32.5	32.6	32.8	33.0	33.1
32	32.2	32.3	32.5	32.6	32.7	32.9	33.0	33.2	33.3	33.4	33.6	33.7	33.9	34.0	34.2
33	33.2	33.3	33.5	33.6	33.8	33.9	34.0	34.2	34.3	34.5	34.6	34.7	34.9	35.1	35.2
34	34.2	34.3	34.5	34.6	34.8	34.9	35.0	35.2	35.3	35.5	35.6	35.8	36.0	36.1	36.3
35	35.2	35.3	35.5	35.6	35.8	35.9	36.1	36.2	36.4	36.5	36.7	36.8	37.0	37.2	37.3

DIRECTIONS.—Bring the temperature of the milk to within 10° from 60° F. Take the reading of the lactometer and that of the temperature of the milk; find the former in the first vertical column of the table and the latter in the first horizontal row of figures; the figure where the horizontal and vertical columns meet is the corrected lactometer reading; e.g., observed, 31.0 at 67° F.; corrected reading, 31.9.

CALCULATION OF TOTAL SOLIDS OF MILK.

The relation existing between the various components of the milk is such as to make possible the calculation of the percentage of solids not fat, and total solids, in a sample of milk when the fat-content and the specific gravity (lactometer reading) of the milk are known. Several formulas have been worked out by chemists in different parts of the world, by the application of which the total solids may be calculated from the percentage of fat and the specific gravity of the milk. We give here Babcock's formula, published in the twelfth report of Wisconsin Experiment Station.

$$\text{Solids not fat} = \left(\frac{100s - sf}{100 - 1.0753sf} - 1\right) \times (100 - f)\,2.5,$$

where s = specific gravity of the milk and f per cent of fat found. When s and f are known the per cent of solids not fat in the milk may be calculated by means of this formula. In order to avoid making the lengthy calculations in every case, tables for solids not fat are given on the following pages; results obtained by the formula given above, or by means of the following tables, will come within a couple of tenths from the actual percentages present, when reasonable care is taken in the determinations of fat and specific gravity (or lactometer reading).

Short formulas. The following formulas for solids not fat and for total solids are derived from the data given in the following tables. L = lactometer reading at 60° F. (specific gravity × 1000 − 1000); f = per cent of fat in milk.

$$\text{Solids not fat} = \frac{L}{4} + .2f$$

$$\text{Total solids} = \frac{L}{4} + 1.2f.$$

Rule: To find per cent of solids not fat, add two tenths of the per cent of fat to one fourth of the lactometer reading.

To find per cent of total solids, add one and two tenths times the per cent of fat to one fourth of the lactometer reading.

Results obtained by using the short formulas will agree very closely with those derived from the general formula, or from the tables published below, and may be safely relied upon in practical work.

The tables cover a range of .0 to 6.0 per cent of fat, and from 26 to 36 lactometer reading. If intermediate values for f and L are at hand, corrections in the per cent of solids not fat found may easily be made, with .02 per cent for every tenth of one per cent of fat, and .25 per cent for every lactometer degree. *Example:* Given $f =$ 3.67 per cent and $L = 32.5$. By referring to the table we find that $f = 3.6$ and $L = 32$ will give 8.73 per cent of solids not fat; correction for fat-content, .01 per cent (3.67 being nearer 3.65 than 3.70), and for lactometer reading, 12 per cent; corrected per cent solids not fat, 8.86.

TABLE SHOWING PER CENT OF TOTAL SOLIDS IN MILK.

Corresponding to Quevenne Lactometer Readings and Per Cent of Fat. (BABCOCK, modified by LEACH.)

Per Ct. of Fat	Lactometer Reading at 60° Fahrenheit.										Per Ct. of Fat
	27	28	29	30	31	32	33	34	35	36	
0.0	6.75	7.00	7.25	7.50	7.75	8.00	8.25	8.50	8.75	9.00	0.0
0.1	6.87	7.12	7.37	7.62	7.87	8.12	8.37	8.62	8.87	9.12	0.1
0.2	6.99	7.24	7.49	7.74	7.99	8.24	8.49	8.74	8.99	9.24	0.2
0.3	7.11	7.36	7.61	7.86	8.11	8.36	8.61	8.86	9.11	9.36	0.3
0.4	7.23	7.48	7.73	7.98	8.23	8.48	8.73	8.98	9.23	9.48	0.4
0.5	7.35	7.60	7.85	8.10	8.35	8.60	8.85	9.10	9.35	9.60	0.5
0.6	7.47	7.72	7.97	8.22	8.47	8.72	8.97	9.22	9.47	9.72	0.6
0.7	7.59	7.84	8.09	8.34	8.59	8.84	9.09	9.34	9.59	9.84	0.7
0.8	7.71	7.96	8.21	8.46	8.71	8.96	9.21	9.46	9.71	9.96	0.8
0.9	7.83	8.08	8.33	8.58	8.83	9.08	9.33	9.58	9.83	10.08	0.9
1.0	7.95	8.20	8.45	8.70	8.95	9.20	9.45	9.70	9.95	10.20	1.0
1.1	8.07	8.32	8.57	8.82	9.07	9.32	9.57	9.82	10.07	10.32	1.1
1.2	8.19	8.44	8.69	8.94	9.19	9.44	9.69	9.94	10.19	10.44	1.2
1.3	8.31	8.56	8.81	9.06	9.31	9.56	9.81	10.06	10.31	10.56	1.3
1.4	8.43	8.68	8.93	9.18	9.43	9.68	9.93	10.18	10.43	10.68	1.4
1.5	8.55	8.80	9.05	9.30	9.55	9.80	10.05	10.30	10.55	10.80	1.5
1.6	8.67	8.92	9.17	9.42	9.67	9.92	10.17	10.42	10.67	10.92	1.6
1.7	8.79	9.04	9.29	9.54	9.79	10.04	10.29	10.54	10.79	11.04	1.7
1.8	8.91	9.16	9.41	9.66	9.91	10.16	10.41	10.66	10.91	11.17	1.8
1.9	9.03	9.28	9.53	9.78	10.03	10.28	10.55	10.78	11.04	11.29	1.9
2.0	9.15	9.40	9.65	9.90	10.15	10.40	10.66	10.91	11.16	11.41	2.0
2.1	9.27	9.52	9.77	10.02	10.27	10.52	10.78	11.03	11.28	11.53	2.1
2.2	9.39	9.64	9.89	10.14	10.39	10.64	10.90	11.15	11.40	11.65	2.2
2.3	9.51	9.76	10.01	10.26	10.51	10.76	11.02	11.27	11.52	11.77	2.3
2.4	9.63	9.88	10.13	10.38	10.63	10.88	11.14	11.39	11.64	11.89	2.4
2.5	9.75	10.00	10.25	10.50	10.75	11.00	11.26	11.51	11.76	12.01	2.5
2.6	9.87	10.12	10.37	10.62	10.87	11.12	11.38	11.63	11.88	12.13	2.6
2.7	9.99	10.24	10.49	10.74	10.99	11.24	11.50	11.75	12.00	12.25	2.7
2.8	10.11	10.36	10.61	10.86	11.11	11.37	11.62	11.87	12.12	12.37	2.8
2.9	10.23	10.48	10.73	10.98	11.23	11.49	11.74	11.99	12.24	12.49	2.9
3.0	10.35	10.60	10.85	11.10	11.36	11.61	11.86	12.11	12.36	12.61	3.0
3.1	10.47	10.72	10.97	11.23	11.48	11.73	11.98	12.23	12.48	12.74	3.1
3.2	10.59	10.84	11.09	11.35	11.60	11.85	12.10	12.35	12.61	12.86	3.2
3.3	10.71	10.96	11.22	11.47	11.72	11.97	12.22	12.48	12.73	12.98	3.3
3.4	10.83	11.09	11.34	11.59	11.84	12.09	12.34	12.60	12.85	13.10	3.4
3.5	10.95	11.21	11.46	11.71	11.96	12.21	12.46	12.72	12.97	13.22	3.5
3.6	11.08	11.33	11.58	11.83	12.08	12.33	12.58	12.84	13.09	13.34	3.6
3.7	11.20	11.45	11.70	11.95	12.20	12.45	12.70	12.96	13.21	13.46	3.7
3.8	11.32	11.57	11.82	12.07	12.32	12.57	12.82	13.08	13.33	13.58	3.8
3.9	11.44	11.69	11.94	12.19	12.44	12.69	12.94	13.20	13.45	13.70	3.9
4.0	11.56	11.81	12.06	12.31	12.56	12.81	13.06	13.32	13.57	13.83	4.0
4.1	11.68	11.93	12.18	12.43	12.68	12.93	13.18	13.44	13.69	13.95	4.1
4.2	11.80	12.05	12.30	12.55	12.80	13.05	13.31	13.56	13.82	14.07	4.2
4.3	11.92	12.17	12.42	12.67	12.92	13.18	13.43	13.68	13.94	14.19	4.3
4.4	12.04	12.29	12.54	12.79	13.04	13.30	13.55	13.80	14.06	14.31	4.4

TABLE FOR SOLIDS—(*Continued*).

Per Ct. of Fat	Lactometer Reading at 60° Fahrenheit										Per Ct. of Fat
	27	28	29	30	31	32	33	34	35	36	
4.5	12.16	12.41	12.66	12.91	13.16	13.42	13.67	13.92	14.18	14.43	4.5
4.6	12.28	12.53	12.78	13.03	13.28	13.54	13.79	14.04	14.30	14.55	4.6
4.7	12.40	12.65	12.90	13.15	13.40	13.66	13.91	14.16	14.42	14.67	4.7
4.8	12.52	12.77	13.02	13.27	13.52	13.78	14.03	14.28	14.54	14.79	4.8
4.9	12.64	12.89	13.14	13.39	13.64	13.90	14.15	14.40	14.66	14.91	4.9
5.0	12.76	13.01	13.26	13.51	13.76	14.02	14.27	14.52	14.78	15.03	5.0
5.1	12.88	13.13	13.38	13.63	13.89	14.14	14.39	14.64	14.90	15.15	5.1
5.2	13.00	13.25	13.50	13.75	14.01	14.26	14.51	14.76	15.02	15.27	5.2
5.3	13.12	13.37	13.62	13.87	14.13	14.38	14.63	14.88	15.14	15.39	5.3
5.4	13.24	13.49	13.74	14.00	14.25	14.50	14.76	15.01	15.26	15.51	5.4
5.5	13.36	13.61	13.86	14.12	14.37	14.62	14.88	15.13	15.38	15.63	5.5
5.6	13.48	13.73	13.99	14.24	14.49	14.75	15.00	15.25	15.50	15.75	5.6
5.7	13.60	13.85	14.11	14.36	14.61	14.87	15.12	15.37	15.62	15.87	5.7
5.8	13.72	13.97	14.22	14.48	14.74	14.99	15.24	15.49	15.74	15.99	5.8
5.9	13.84	14.10	14.35	14.60	14.86	15.11	15.36	15.61	15.86	16.12	5.9
6.0	13.96	14.22	14.47	14.72	14.98	15.23	15.48	15.73	15.98	16.24	6.0

Correction for Tenths of Lactometer Readings.

	Difference.	
	.25	.26
.1	.03	.03
.2	.05	.05
.3	.08	.08
.4	.10	.10
.5	.13	.13
.6	.15	.16
.7	.18	.18
.8	.20	.21
.9	.23	.23

CALCULATION OF SP. GR. OF MILK SOLIDS.

(FLEISCHMANN.)

$$\text{Sp. gr. of milk solids} = S = \frac{t}{t - \dfrac{100s - 100}{s}}$$

where s = sp. gr. of milk, t = solids of milk. In pure whole milk S varies but little, viz., between 1.25 and 1.34. When S comes above 1.34, the milk is suspicious; if above 1.40, it has been skimmed (see page 313).

LEGAL STANDARDS FOR DAIRY PRODUCTS, 1913.

(U. S. Dept. of Agriculture.)

States.	Milk.			Skim Milk.	Cream.	Butter.	Whole Milk Cheese.	Condensed Milk.		Ice Cream. (Plain).	Ice Cream. (Fruit and Nut).
	Total Solids.	Solids not Fat.	Fat.	Total Solids.	Fat.	Fat.	Fat.	Total Solids.	Fat.	Fat.	Fat.
	Pr. Ct.	Pr. Ct.	Pr. Ct.	Pr. Ct.	Pr. Ct.	Pr. Ct.	Pr. Ct.	Pr. Ct.	Pr. Ct.	Pr. Ct.	Pr. Ct.
Alabama					No State Standards.						
Arizona					No State Standards.						
Arkansas					Federal Rulings adopted.						
California	11.5	8.5	3.0	8.8	18.0	80.0	50 [1]	([2])	([2])	12	......
Colorado	......	......	3.0	......	16.0 [3]	80.0	50 [1]	......	......	14	12
Connecticut	11.75	8.5	3.25	......	16.0	......	......	......	......	......	......
Delaware					No State Standards.						
District of Columbia	12.5	9.0	3.5	9.3	20.0	83.0	......	......	......	......	......
Florida	11.75	8.5	3.25	9.25	18.0	82.5	50 [1]	28.0 [4]	7.7 [4]	12	......
Georgia	11.75	8.5	3.25	9.25	18.0	82.5	50 [1]	28.0	27.66 [1]	14	12
Hawaii [5]	11.5	8.5	3.0	......	......	......	......	28.0	7.7	......	......
Idaho	11.2	8.0	3.2	9.3	18.0	82.5	30	([2])	([2])	14	12
Illinois	11.5	8.5	3.0	9.25	18.0	82.5	50 [1]	([2])	([2])	8	......
Indiana	......	8.5	3.25	9.26	18.0	82.5	50 [1]	28.0	27.5 [1]	8	......
Iowa	12.0	......	3.0	......	16.0	80.0 [6]	......	......	......	12	......
Kansas	11.75	8.5	3.25	9.25	18.0 [3]	80.0	50 [1]	([2])	([2])	14	12
Kentucky	12.5	8.5	3.25	9.26	18.0	82.5	50 [1]	28.0	26.76 [1]	14	12
Louisiana	......	8.5	3.5	8.0	18.0	......	......	([2])	([2])	......	......
Maine	11.75	8.5	3.25	......	18.0	......	......	......	......	......	......
Maryland	12.5	......	3.5	9.25	18.0	......	......	([2])	([2])	4	6
Massachusetts	12.15	......	3.25	9.3	15.0	......	......	......	......	......	......

Michigan	12.5	......	3.0	......	......	......	......	......	......	12	......
Minnesota	13.0	9.75	3.25	......	20.0	......	45[1]	(2)	(2)	12	......
Mississippi	No State Standards.										
Missouri	12.0	8.75	3.25	9.25	18.0	8.25	50[1]	28.0	7.76[2]	14	......
Montana	11.75	8.5	3.25	......	20.0	8.25	50[1]	......	......	14	......
Nebraska	......	......	3.0	......	18.0	......	......	......	......	14	12
New Hampshire	12.0	......	......	8.5	18.0	80.0	......	......	......	14[7]	......
New Jersey	11.5	......	3.0	......	16.0	......	......	......	......	......	......
New Mexico	No State Standards.										
New York	11.5	......	3.0	......	18.0	......	......	(8)	25.0[1]	......	......
Nevada	11.75	8.5	3.25	9.25	18.0	82.5	50[1]	26.5	7.8	14	......
North Carolina	11.75	8.5	3.25	9.25	18.0	82.5	50[1]	28.0	27.5[1]	14	12
North Dakota	12.0	9.0	3.0	......	15.0	......	......	......	......	14	......
Ohio	12.0	......	3.0	......	......	80.0[9]	......	(10)	25.0[1]	......	......
Oklahoma	12.5	9.5	3.0	......	18.0	81.5	......	......	......	14	......
Oregon	......	9.0	3.2	......	20.0	......	30.0	(11)	(11)	12	......
Pennsylvania	12.0	......	3.25	......	18.0	......	32.0	......	......	8	6
Porto Rico	12.0	9.0	3.0	......	......	......	......	......	......	......	......
Rhode Island	12.0	......	2.5	......	......	......	......	......	......	......	......
South Carolina	No State Standards.										
South Dakota	......	8.5	3.25	9.25	18.0	80.0	50[1]	28.0	27.5[1]	14	12
Tennessee	......	8.5	3.25	......	......	......	......	......	......	......	......
Texas	......	8.5	3.25	......	......	......	......	......	......	......	......
Utah	12.0	9.0	3.2	9.0	18.0	80.0	50[1]	(2)	(2)	14	12
Vermont	12.5[12]	9.25	......	......	......	......	......	......	......	......	......
Virginia	11.75	8.5	3.25	9.25	18.0	82,5	......	(2)	(2)	8	......
Washington	12.0	8.75	3.25	9.3	18.0	......	30	......	......	......	......
West Virginia	No State Standards.										
Wisconsin	......	8.5	3.0	9.0	18.0	82.5	50[1]	28.0	8.0	14	......
Wyoming	......	8.5	3.25	9.25	18.0	82.5	50[1]	28.0	(13)	14	12

[1] Percentage of fat based on total solids. [2] Fat, 7.8 per cent; total solids plus fat, 34.3 per cent. [3] For butter-making, 25 per cent fat. [4] This standard for sweetened condensed milk; "Evaporated milk," solids, 24 per cent; fat, 7.8 per cent. [5] No report; 1910 standard given. [6] By weight. [7] Not more than 0.2 per cent "filler." [8] Must correspond to 11.5 per cent solids in crude milk. [9] If artificially colored. [10] Must correspond to 12 per cent solids in crude milk. [11] 23–24 per cent solids, 7.9 per cent fat; 24–25 per cent solids, 7.8 per cent fat; 25–26 per cent solids, 7.7 per cent fat; 26 per cent solids, 7.6 per cent fat. [12] In May and June, solids 12 per cent. [13] Fat, 27.5 per cent of total solids.

GOVERNMENT STANDARDS OF PURITY FOR MILK AND ITS PRODUCTS.*

A.—Milks.

1. *Milk* is the fresh, clean, lacteal secretion obtained by the complete milking of one or more healthy cows, properly fed and kept, excluding that obtained within fifteen days before and ten days after calving, and contains not less than eight and one-half (8.5) per cent of solids not fat, and not less than three and one-quarter (3.25) per cent of milk-fat.

2. *Blended milk* is milk modified in its composition so as to have a definite and stated percentage of one or more of its constituents.

3. *Skim milk* is milk from which a part or all of the cream has been removed, and contains not less than nine and one-quarter (9.25) per cent of milk solids.

4. *Pasteurized milk* is milk that has been heated below boiling, but sufficiently to kill most of the active organisms present, and immediately cooled to 50° Fahr. or lower.

5. *Sterilized milk* is milk that has been heated at the temperature of boiling water or higher for a length of time sufficient to kill all organisms present.

6. *Condensed milk*, *evaporated milk*, is milk from which a considerable portion of water has been evaporated, and contains not less than twenty-eight (28) per cent of milk solids, of which not less than twenty-seven and five-tenths (27.5) per cent is milk-fat.

7. *Sweetened condensed milk* is milk from which a considerable portion of water has been evaporated and to which sugar (sucrose) has been added, and contains not less than twenty-eight (28) per cent of milk solids, of which not less than twenty-seven and five-tenths (27.5) per cent is milk-fat.

8. *Condensed skim milk* is skim milk from which a considerable portion of water has been evaporated.

9. *Buttermilk* is the product that remains when butter is removed from milk or cream in the process of churning.

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* Proclaimed by the Secretary of Agriculture, June 26, 1906. (Circ. No. 19, Office of the Secretary, U. S. Dept. of Agriculture.)

10. *Goat's milk*, *ewe's milk*, *et cetera*, are the fresh, clean, lacteal secretions, free from colostrum, obtained by the complete milking of healthy animals other than cows, properly fed and kept, and conform in name to the species of animal from which they are obtained.

B.—Cream.

1. *Cream* is that portion of milk rich in milk-fat, which rises to the surface of milk on standing, or is separated from it by centrifugal force, is fresh and clean, and contains not less than eighteen (18) per cent of milk-fat.

2. *Evaporated cream*, *clotted cream*, is cream from which a considerable portion of water has been evaporated.

C.—Milk-Fat or Butter-Fat.

1. *Milk-fat*, *butter-fat*, is the fat of milk and has a Reichert-Meissl number not less than twenty-four (24) and a specific gravity not less than 0.905 $\left(\frac{40° \text{ C.}}{40° \text{ C.}}\right)$.

D.—Butter.

1. *Butter* is the clean, non-rancid product made by gathering in any manner the fat of fresh or ripened milk or cream into a mass, which also contains a small portion of the other milk constituents, with or without salt, and contains not less than eighty-two and five-tenths (82.5) per cent of milk-fat. By acts of Congress approved August 2, 1886, and May 9, 1902, butter may also contain added coloring-matter.

2. *Renovated butter*, *process butter*, is the product made by melting butter and reworking, without the addition or use of chemicals or any substances except milk, cream, or salt, and contains not more than sixteen (16) per cent of water and at least eighty-two and five-tenths (82.5) per cent of milk-fat.

E.—Cheese.

1. *Cheese* is the sound, solid, and ripened product made from milk or cream by coagulating the casein thereof with rennet or lactic acid, with or without the addition of ripening ferments

and seasoning, and contains, in the water-free substance, not less than fifty (50) per cent of milk-fat. By act of Congress, approved June 6, 1896, cheese may also contain added coloring-matter.

2. *Skim milk cheese* is the sound, solid, and ripened product made from skim milk by coagulating the casein thereof with rennet or lactic acid, with or without the addition of ripening ferments and seasoning.

3. *Goat's milk cheese*, *ewe's milk cheese*, *et cetera*, are the sound ripened products made from the milks of the animals specified by coagulating the casein thereof with rennet or lactic acid, with or without the addition of ripening ferments and seasoning.

F.—Ice Creams.

1. *Ice cream* is a frozen product made from cream and sugar, with or without a natural flavoring, and contains not less than fourteen (14) per cent of milk-fat.

2. *Fruit ice cream* is a frozen product made from cream, sugar, and sound, clean, mature fruits, and contains not less than twelve (12) per cent of milk-fat.

3. *Nut ice cream* is a frozen product made from cream, sugar, and sound, non-rancid nuts, and contains not less than twelve (12) per cent of milk-fat.

G.—Miscellaneous Milk Products.

1. *Whey* is the product remaining after the removal of fat and casein from milk in the process of cheese-making.

2. *Kumiss* is the product made by the alcoholic fermentation of mare's or cow's milk.

ADULTERATION OF MILK.

The legal standards adopted in the different States of the Union determine the limits for fat or solids, below which the milk offered for sale must not fall. Where no control sample can be taken of a suspected sample of milk, calculations of the extent of the adulteration practised are made on basis of the legal standard in each State. Whenever possible, a control sample should be secured on the premises of the suspected party, and subjected to analysis. If the control sample contains appreciably less fat or solids not fat than did the suspected sample, the latter was skimmed or watered, or both skimmed and watered.*

SKIMMING.—I. If a sample is skimmed, the following formula will give the number of pounds of fat abstracted from 100 lbs. of milk:

$$\text{Fat abstracted} = x = \text{legal standard for fat} - f, \quad \text{(I)}$$

f being the per cent of fat in the suspected sample.

In this and following formulas the percentages found in the control samples, if such are at hand, are always to be substituted for the legal standards.

II. The following formula will give the per cent of fat abstracted, calculated on the total quantity of fat originally found in the milk:

$$x = 100 - \frac{f \times 100}{\text{leg. stand. for fat}}. \quad \text{(II)}$$

WATERING.—I. If a sample is watered, the calculations are most conveniently based on the percentage of solids not fat in the milk:

Per cent extraneous water in milk

$$= x = 100 - \frac{s \times 100}{\text{leg. stand. for solids not fat}}, \quad \text{(III)}$$

s being the per cent of solids not fat in the suspected sample.

Example.—A sample contains 8.5 per cent of solids not fat; if the legal standard for solids not fat be 9 per cent, $100 - \frac{8.5 \times 100}{9} = 5.6$, will give the per cent of extraneous water in the suspected sample of milk.

* See *Farrington-Woll*, Testing Milk and its Products, 22d Ed., pp. 111–117.

II. Watering of milk may also be expressed in per cent of water added to the original milk, by formula IV:

Per cent water added to original milk

$$= x = \frac{100 \times \text{leg. stand. for solids not fat}}{s} - 100. \qquad \text{(IV)}$$

In the example given above, $\frac{100 \times 9}{8.5} - 100 = 5.9$ per cent of water was added to the original milk.

WATERING AND SKIMMING.—If a sample has been both watered and skimmed, the extent of watering is ascertained by means of formula III; and the fat abstracted found according to the following formula:

Per cent fat abstracted

$$= x = \text{leg. stand. for fat} - \frac{\text{leg. stand. for solids not fat}}{s} \times f. \qquad \text{(V)}$$

Example.—A sample of milk contains 2.4 per cent of fat and 8.1 per cent solids not fat; then

$$\text{extraneous water in milk} = 100 - \frac{8.1 \times 100}{9} = 10 \text{ per cent;}$$

$$\text{fat abstracted} = 3 - \frac{9 \times 2.4}{8.1} = .33 \text{ per cent.}$$

100 lbs. of the milk contained 10 lbs. of extraneous water and .33 lb. of fat had been skimmed from it.

RANGES OF THE VARIATIONS IN THE COMPOSITION OF HERD MILK. (FLEISCHMANN.)

The specific gravity (expressed in degrees) may go above or below the yearly average by more than 10 per cent.

The per cent of fat may go above or below the yearly average by more than 30 per cent.

The per cent of total solids may go above or below the yearly average by more than 14 per cent.

The per cent of solids not fat may go above or below the yearly average by more than 10 per cent.

TABLE FOR CONVERTING QUARTS OF MILK INTO POUNDS.

Qts.	Lbs.	Qts.	Lbs.	Qts.	Lbs.	Qts	Lbs.
1	2.15	29	62.3	57	122.4	85	182.5
2	4.3	30	64.4	58	124.5	86	184.6
3	6.4	31	66.5	59	126.6	87	186.8
4	8.6	32	68.7	60	128.8	88	188 9
5	10 7	33	70.8	61	130.9	89	191 0
6	12.9	34	73.0	62	133.1	90	193.2
7	15.0	35	75.1	63	135.2	91	195.3
8	17.2	36	77.3	64	137.4	92	197.5
9	19.3	37	79.4	65	139.5	93	199.6
10	21.5	38	81.6	66	141.7	94	201 8
11	23.6	39	83.7	67	143.8	95	203.9
12	25.8	40	85.9	68	146.0	96	206.1
13	27.9	41	88.0	69	148.1	97	208.2
14	30.1	42	90.2	70	150.3	98	210.4
15	32.2	43	92.3	71	152.4	99	212.5
16	34.3	44	94.5	72	154.6	100	214.7
17	36.5	45	96.6	73	156.7	200	429.3
18	38.6	46	98.7	74	158.8	300	644.0
19	40.8	47	100.9	75	161.0	400	858 6
20	42.9	48	103.0	76	163.1	500	1073.3
21	45.1	49	105.2	77	165.3	600	1288 0
22	47.2	50	107.3	78	167.4	700	1502.6
23	49.4	51	109.5	79	169.6	800	1717.3
24	51.5	52	111.6	80	171.7	900	1931.9
25	53.7	53	113.8	81	173.9	1000	2146.6
26	55.8	54	115.9	82	176.0		
27	58.0	55	118.1	83	178.2		
28	60.1	56	120.2	84	180.3		

TABLE FOR CONVERTING POUNDS OF MILK INTO QUARTS.

Lbs.	Qts.	Lbs.	Qts	Lbs.	Qts.	Lbs.	Qts.
1	.47	29	13.5	57	26.6	85	39.6
2	.93	30	14.0	58	27.0	86	40.1
3	1.40	31	14.4	59	27.5	87	40.5
4	1.86	32	14.9	60	28.0	88	41.0
5	2.33	33	15.4	61	28.4	89	41.5
6	2 80	34	15.8	62	28.9	90	41.9
7	3.26	35	16.3	63	29.4	91	42.4
8	3.73	36	16.8	64	29.8	92	42.9
9	4.19	37	17.2	65	30.3	93	43.3
10	4.66	38	17.7	66	30.8	94	43.8
11	5.13	39	18.2	67	31.2	95	44.3
12	5.59	40	18.6	68	31.7	96	44.7
13	6 06	41	19.1	69	32.2	97	45.2
14	6.52	42	19.6	70	32.6	98	45.7
15	6.99	43	20.0	71	33.1	99	46.1
16	7.46	44	20.5	72	33.6	100	46.6
17	7.92	45	21.0	73	34.0	200	93.2
18	8.39	46	21.4	74	34.5	300	139.8
19	8.85	47	21.9	75	35.0	400	186.4
20	9.32	48	22 4	76	35.4	500	233.0
21	9.79	49	22.8	77	35.9	600	279.6
22	10.3	50	23.3	78	36.3	700	326.2
23	10.7	51	23.8	79	36.8	800	372.8
24	11.2	52	24.2	80	37.3	900	419.4
25	11.7	53	24.7	81	37.7	1000	466.0
26	12.1	54	25.2	82	38.2		
27	12.6	55	25.6	83	38.7		
28	13.1	56	26.1	84	39.1		

MILK PRICES BY MEASURES.

(N. Y. Farmer.)

Cents per Quart.	Cents per 40-qt. Can.	Cents per 100 Pounds.	Cents per Quart.	Cents per 40-qt. Can.	Cents per 100 Pounds.
1.100	44	51.162	2.375	95	110.465
1.125	45	52.325	2.400	96	111.628
1.150	46	53.488	2.425	97	112.791
1.175	47	54.651	2.450	98	113.053
1.200	48	55.813	2.475	99	115.116
1.225	49	56.976	2.500	100	116.279
1.250	50	58.189	2.525	101	117.442
1.275	51	59.302	2.550	102	118.605
1.300	52	60.465	2.575	103	119.767
1.325	53	61.627	2.600	104	120.930
1.350	54	62.790	2.625	105	122.093
1.375	55	63.953	2.650	106	123.256
1.400	56	65.116	2.675	107	124.419
1.425	57	66.279	2.700	108	125.581
1.450	58	67.441	2.725	109	126.744
1.475	59	68.604	2.750	110	127.907
1.500	60	69.767	2.775	111	129.070
1.525	61	70.930	2.800	112	130.233
1.550	62	72.093	2.825	113	131.395
1.575	63	73.255	2.850	114	132.558
1.600	64	74.418	2.875	115	133.721
1.625	65	75.581	2.900	116	134.884
1.650	66	76.744	2.925	117	136.047
1.675	67	77.907	2.950	118	137.209
1.700	68	79.069	2.975	119	138.372
1.725	69	80.232	3.000	120	139.535
1.750	70	81.395	3.025	121	140.698
1.775	71	82.558	3.050	122	141.861
1.800	72	83.721	3.075	123	143.023
1.825	73	84.883	3.100	124	144.186
1.850	74	86.046	3.125	125	145.349
1.875	75	87.209	3.150	126	146.512
1.900	76	88.372	3.175	127	147.675
1.925	77	89.535	3.200	128	148.837
1.950	78	90.697	3.225	129	150.000
1.975	79	91.860	3.250	130	151.163
2.000	80	93.023	3.275	131	152.326
2.025	81	94.186	3.300	132	153.489
2.050	82	95.349	3.325	133	154.651
2.075	83	96.511	3.350	134	155.814
2.100	84	97.674	3.375	135	156.977
2.125	85	98.837	3.400	136	158.140
2.150	86	100.000	3.425	137	159.303
2.175	87	101.163	3.450	138	160.465
2.200	88	102.325	3.475	139	161.628
2.225	89	103.488	3.500	140	162.791
2.250	90	104.651	3.525	141	163.954
2.275	91	105.814	3.550	142	165.117
2.300	92	106.977	3.575	143	166.279
2.325	93	108.139	3.600	144	167.442
2.350	94	109.302	3.625	145	168.605

MILK PRICES BY MEASURES.—*Continued.*

Cents per Quart.	Cents per 40-qt. Can.	Cents per 100 Pounds.	Cents per Quart.	Cents per 40-qt. Can.	Cents per 100 Pounds.
3.650	146	169.768	3.975	159	184.884
3.675	147	170.931	4.000	160	186.047
3.700	148	172.093	4.025	161	187.210
3.725	149	173.256	4.050	162	188.373
3.750	150	174.419	4.075	163	189.535
3.775	151	175.582	4.100	164	190.698
3.800	152	176.745	4.125	165	191.861
3.825	153	177.907	4.150	166	193.024
3.850	154	179.070	4.175	167	194.187
3.875	155	180.233	4.200	168	195.349
3.900	156	181.396	4.225	169	196.512
3.925	157	182.559	4.250	170	197.675
3.950	158	183.721	4.275	171	198.838

RELATIVE VALUE OF MILK AND CREAM OF DIFFERENT FAT CONTENTS.

(FRASER)

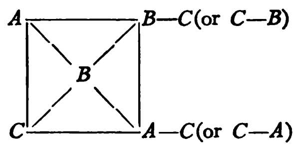
The table gives the relative value per quart and number of quarts in a dollar's worth of milk or cream of different fat contents, calculated according to the food value of 3-per-cent. milk at 5 cents per quart.

Per Cent of Fat.	Price per Quart, Cents.	No. of Quarts a Dollar.	Per Cent of Fat.	Price per Quart, Cents.	No. of Quarts a Dollar.
0.1	2.8	35.7	17	15.5	6.4
1	3.5	28.6	18	16.3	6.1
2	4.2	23.8	19	17.0	5.9
3	5.0	20.0	20	17.7	5.6
4	5.7	17.5	21	18.4	5.4
5	6.5	15.4	22	19.2	5.2
6	7.2	13.9	23	20.0	5.0
7	8.0	12.5	24	20.7	4.8
8	8.7	11.5	25	21.5	4.6
9	9.5	10.5	26	22.2	4.5
10	10.2	9.8	27	23.0	4.3
11	11.0	9.0	28	23.7	4.2
12	11.7	8.5	29	24.5	4.1
13	12.5	8.0	30	25.2	4.0
14	13.2	7.6	31	26.0	3.8
15	14.0	7.1	32	26.7	3.7
16	14.7	6.8			

AMOUNTS OF MILK, CREAM, OR SKIM MILK TO BE USED IN MODIFYING MILK. (Pearson.)

The amounts of cream or skim milk that are to be used in modifying normal milk may be calculated by use of the following simple method:

Draw a square and write at the two left-hand corners the percentages of fat in the milk and the cream or skim milk that are to be mixed. In the centre place the percentage required. The differences between the latter figures and those at the left-hand corners are then placed at the two corners with which they stand in line. The two right-hand figures will represent the proportions of milk and cream or skim milk that should be weighed out in making the modified milk.



Example.—How much 5 per cent milk must be added to milk containing 3.5 per cent fat in order to raise its fat content to 4 per cent? In this case $A=3.5$, $B=4$, and $C=5$ (see above); then $B-C=1.0$ and $A-B=.5$. $\frac{1.0}{1.5}\times 100=.66.7$ and $\frac{.5}{1.5}\times 100=3.33$. To make, say, 1000 lbs. of 4 per cent milk 667 lbs. of 3.5 per cent and 333 lbs. of 5 per cent milk must therefore be taken.

This method of calculation may be used to advantage in modifying or standardizing milk or cream, with either cream, new milk, or skim milk, whether a product of a higher or lower fat content is wanted than that at hand.

STANDARDIZATION OF MILK.

(Erf.)

QUANTITY OF SKIM MILK TO BE ADDED TO, OR SUBTRACTED FROM, 100 POUNDS OF MILK TO MAKE MILK OF A DESIRED PER CENT. OF FAT.

Per Cent. Fat in Milk on Hand.	Desired Per Cent. of Fat.							
	3.25	3.50	3.75	4.0	4 25	4.50	4.75	5.0
3.	− 7 693	−14.285	−20.000	−25.00	−29.412	−33.333	−36.842	−40.000
3.1	− 4 616	−11.428	−17.333	−22.50	−27 059	−31.111	−34.737	−38.000
3.2	− 1.539	− 8 571	−14.666	−20.00	−24 706	−28 888	−32.632	−36.000
3.3	+ 1 539	− 5.714	−12.000	−17.50	−22.353	−26.666	−30.527	−34 000
3 4	+ 4.616	− 2.857	− 9.333	−15 00	−20.000	−24 444	−28.422	−32.000
3 5	+ 7 693	− 0.000	− 6 666	−12 50	−17 647	−22.222	−26.317	−20.000
3 6	+10.760	+ 2.857	− 4.000	−10 00	−15.294	−20 000	−24.212	−28 000
3 7	+13 837	+ 5.714	− 1.333	− 7.50	−12.941	−17 777	−22.107	−26.000
3 8	+10 914	+ 8.571	+ 1.333	− 5 00	−10.588	−15.555	−20.000	−24.000
3.9	+19.991	+11.428	+ 4.000	− 2.50	− 8.235	−13.333	−17.897	−22.000
4.0	+23.065	+14.285	+ 6.666	− 0.00	− 5.882	−11.111	−15.702	−20 000
4 1	+26.145	+17.142	+ 9.333	+ 2.50	− 2.429	− 8.888	−13.687	−18.000
4 2	+29.222	+19.999	+12.000	+ 5.00	− 0.076	− 6.666	−11 582	−16.000
4 3	+32.299	+22.856	+14.666	+ 7.50	+ 0.076	− 4.444	− 9.477	−14 000
4 4	+35.376	+25.713	+17.333	+10 00	+ 2.429	− 2.222	− 7.372	−12.000
4 5	+38.453	+28.57	+20.000	+12.50	+ 5.882	− 0.000	− 5.267	−10 000
4 6	+41.530	+31.427	+22.666	+15.00	+ 8.235	+ 2 222	− 3.162	− 8.000
4 7	+44 607	+34.284	+25.333	+17 50	+10.588	+ 4.444	− 1.057	− 6.000
4.8	+47 684	+37.141	+28.000	+20.00	+12.941	+ 6 666	+ 1.057	− 4 000
4.9	+50.761	+39.998	+30.666	+22 50	+17 647	+ 8 888	+ 3.162	− 2.000
5.0	+53.838	+42.855	+33.333	+25 00	+20.000	+11 111	+ 5 267	− 0.000

To find the pounds of skim milk to be added or removed, trace the vertical column of the desired per cent of fat to where the horizontal column representing the per cent. of fat in the milk on hand intersects; the result will be the number of pounds of skim milk to be added or removed to 100 lbs. of milk, as indicated by a plus or minus sign before the figure (see Ill. Bull. No. 75).

RULES AND REGULATIONS

to be observed in the care of cows and the handling of milk shipped to the City of New York. (Dept. of Health, City of New York.)

The Cows.—1. The cows must be kept clean.

2. Manure must not be permitted to collect upon the tail, sides, udder, and belly of any milch-cows.

Stables.—1. Cow stables must be well lighted and ventilated.

2. Floors must be tight and well drained.

3. Manure must be removed from the stalls and gutters before the morning milking and also before the afternoon milking, where the cows remain in the stables all day.

4. Walls and ceilings must be kept clean.

5. The ceiling must be so constructed that dust and dirt therefrom shall not readily fall to the floor or into the milk.

6. Stables must be whitewashed at least once a year.

The Water-supply.—1. The water-supply used in the barn and for washing milk utensils must be free from contamination.

The Milk House.—1. A milk house must be provided which is separated from the stable and the dwelling-house.

2. It must be kept clean and must not be used for any purpose except the handling of milk.

The Milkers.—1. No person having any communicable disease, or one caring for persons having such disease, must be allowed to handle the milk or milk utensils.

The Utensils.—1. All milk-utensils, including pails, cans, strainers, and dippers, must be kept thoroughly clean and must be washed and scalded after each using.

The Milk.—1. Milk from diseased cows must not be shipped.

2. The milk must not be in any way adulterated.

3. The straining of milk must be done in the milk house only.

4. All milk must be cooled to a temperature not above 55 deg. F. within two hours after being drawn, and kept thereafter below that temperature, and must be cooled to 50 deg. or less if not delivered at the creamery twice daily.

5. The use of any preservative or coloring matter is an adulteration, and its use by a producer or shipper will be a sufficient cause for the exclusion of his milk from the City of New York.

III. CREAM.

PERCENTAGE COMPOSITION OF CREAM. (König.)

	Mean of 47 Analyses.	Minimum.	Maximum.
Water	67.61	43.04	83.23
Fat	23.80	15.78	30.19
Casein, Albumen, etc.	4.12	1.75	8.19
Milk-sugar	3.92	.62	6.23
Ash	.53	.11	1.10
Specific gravity, 1.100	100.00		

PERCENTAGE COMPOSITION OF DAIRY PRODUCTS. (König.)

	No. of Analyses.	Water.	Fat.	Casein and Albumen.	Milk Sugar.	Ash.	Specific Gravity.	
Skim-milk, gravity creaming	56	90.43	.87	3.26	4.74	.70	1.0357	
Centrifugal skim-milk	7	90.60	.31	3.06	5.29	.74	1.0350	
Buttermilk	57	90.12	1.09	4.03	4.04	.72	1.0348	
Whey	46	93.38	.32	.86	4.79	.65	1.0272	
Preserved milk	4	87 97	3 21	3.34	4.74	.74	1.0313	
Condensed milk, (no sugar added)	36	58.99	12.42	11.92	14.49	2.18		
Condensed milk, (sugar added)	64	25.61	10.35	11.79	50.06*	2.19		
Scherff's condensed milk	5	72.87	6.62	8.20	10.63	1.68	Lactic acid.	Alcohol.
Koumiss (from mares' milk)	43	90.44	1.46	2.24	1.77	.42	.91	1.91
Koumiss (from cows' milk)	11	89.20	1.83	2.66	4.09	.43	.55	1.14
Kephir	22	91.21	1.44	3.49	2.41	.68	1.02	.75

* 13.84 per cent milk-sugar, 36.22 per cent cane-sugar.

YIELD OF CREAM FROM MILK OF DIFFERENT RICHNESS.

Fat in Milk, Per Cent.	Per Cent of Fat in Cream.											
	12	15	18	20	25	30	35	40	45	50	55	60
	Number of Pounds of Cream from 1000 lbs. of Milk.											
3.0	244	195	162	146	116	97	86	73	65	58	53	48
3.1	253	201	168	151	120	100	89	75	67	60	55	50
3.2	261	208	173	156	124	104	92	78	69	62	56	52
3.3	268	215	179	161	129	107	95	80	71	64	58	53
3.4	277	221	184	166	133	110	97	83	74	66	60	55
3.5	286	228	190	171	137	114	100	85	76	68	62	57
3.6	294	235	196	176	141	117	103	88	78	70	64	58
3.7	303	242	201	181	145	120	106	90	80	72	66	60
3.8	311	248	207	186	149	124	109	93	82	74	67	62
3.9	319	255	212	191	153	127	112	95	85	76	69	63
4.0	328	262	218	196	157	130	115	98	87	78	71	65
4.1	336	268	223	201	161	134	117	100	89	80	73	67
4.2	345	275	229	206	165	137	120	103	91	82	75	68
4.3	353	282	235	211	169	140	123	105	94	84	77	70
4.4	361	289	240	216	173	144	126	108	96	86	78	72
4.5	370	295	246	221	177	147	129	110	98	88	80	73
4.6	378	302	251	226	181	150	132	113	100	90	82	75
4.7	387	309	257	231	185	154	135	115	102	92	84	77
4.8	395	315	263	236	189	157	138	118	105	94	86	78
4.9	403	322	268	241	193	161	140	120	107	96	87	80
5.0	412	329	274	246	197	164	143	123	109	98	89	82

CALCULATION OF PER CENT FAT IN CREAM.

The following table shows the per cent of fat in cream corresponding to 3.0 to 4.5 per cent fat in the milk and 9–20 per cent cream, the fat content of the skim-milk being taken as .2 per cent. (After Martiny.)

Cream, per cent.	Per Cent of Fat in the Milk.															
	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5
	Per Cent of Fat in the Cream.															
9	31.1	32.2	33.3	34.4	35.5	36.7	37.8	38.9	40.0	41.1	42.2	43.3	44.4	45.6	46.7	47.8
10	28.0	29.0	30.0	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0	41.0	42.0	43.0
11	25.5	26.4	27.3	28.2	29.1	30.0	30.9	31.8	32.7	33.6	34.5	35.5	36.4	37.3	38.2	39.1
12	23.3	24.2	25.0	25.8	26.7	27.5	28.3	29.2	30.0	30.8	31.7	32.5	33.3	34.2	35.0	35.8
13	21.5	22.3	23.1	23.9	24.6	25.4	26.2	26.9	27.7	28.5	29.2	30.0	30.8	31.5	32.3	33.1
14	20.0	20.7	21.4	22.1	22.9	23.6	24.3	25.0	25.7	26.4	27.1	27.9	28.6	29.3	30.0	30.7
15	18.7	19.3	20.0	20.7	21.3	22.0	22.7	23.3	24.0	24.7	25.3	26.0	26.7	27.3	28.0	28.7
16	17.5	18.1	18.8	19.4	20.0	20.6	21.3	21.9	22.5	23.1	23.8	24.4	25.0	25.6	26.3	27.5
17	16.5	17.1	17.7	18.2	18.8	19.4	20.0	20.6	21.2	21.8	22.4	22.9	23.5	24.1	24.7	25.3
18	15.6	16.1	16.7	17.2	17.8	18.4	18.9	19.4	20.0	20.6	21.1	21.7	22.2	22.8	23.3	23.9
19	14.7	15.3	15.8	16.3	16.8	17.4	17.9	18.4	18.9	19.5	20.0	20.5	21.1	21.6	22.1	22.7
20	14.0	14.5	15.0	15.5	16.0	16.5	17.0	17.5	18.0	18.5	19.0	19.5	20.0	20.5	21.0	21.5

LIST OF HAND AND POWER CREAM SEPARATORS ON THE AMERICAN MARKET, 1913.

Name.	Capacity per Hour.	Retail Price.	Manufacturer or Agency.
	Lbs.		
A. HAND OR DAIRY SEPARATORS.			
1. *De Laval Improved Farm Separators.*			
Nos. 4, 5, 10, 12, 15, 17, 22	135–1350	$40–$160	The De Laval Separator Co., N. Y.
Nos, 19, 20 and 25—Steam Turbine	675–1350	100–175	
2. *U. S. Cream Separators.*			
Nos. 40, 19, 18, 17, 16, 15, 14, 12, Interlocking Style	175–1350	25–135	Vermont Farm Machine Co., Bellows Falls, Vt.
Nos. 15, 14, 12—Interlocking Style Turbine	750–1350	110–150	
3. *The Empire Cream Separators.*			
Nos. 41, 42, 43, 44	350–800	....	Empire Cream Separator Co., Bloomfield, N. J.
Nos. 31, 32, 33, 34, 35, 36—Center Feed Empire Disc	200–1050	....	
4. *Sharples Tubular "A" Cream Separators.*			
Nos. 1, 2, 3, 4, 6, 9	225–950	40–110	The Sharples Separator Co., West Chester, Pa.
Nos. 5, 7, 10—Dairy Steam Tubular	500–1000	80–125	
5. *The "Eclipse" Cream Separators.*			
Nos. 1, 2, 3, 4, 5	400–1600	60–150	The C. L. Chapman Cream Sep. Works, Erie, Pa.
6. *The American Cream Separators.*			
Nos. 10, 11, 12—American Wonder	125–300	15.95–24.95	American Sep. Co., Bainbridge, N. Y.
Nos. 1, 2, 3—American Low-Down	400–700	37.75–47.50	
7. *The Reid Disc Bracket Cream Separators.*			
Nos. 1, 2, 3	300–600	45–65	A. H. Reid Cry. & Dairy Supply Co., Phila., Pa.
8. *Simplex Link Blade Cream Separators.*			
Nos. 3½, 5, 7, 9, 11—Hand Power	350–1100	70–100	D. H. Burrell Co., Little Falls, N. Y.
Nos. 7, 9, 11—Dairy Turbines	700–1100	110–130	
9. *The National Cream Separators.*			
Nos. 22, 24, 26, 28	325–800	60–100	National Dairy Machine Co., Goshen, Ind.
10. *The Iowa Dairy Separators.*			
Nos. 25, 30, 35	500–850	75–100	Iowa Dairy Separator Co., Waterloo, Iowa.

LIST OF HAND AND POWER CREAM SEPARATORS.
(*Continued.*)

Name.	Capacity per Hour.	Retail Price.	Manufacturer or Agency.
11. *Peerless Cream Separators.* Nos. 5, 7, 9	Lbs. 500–900	40–60	Peerless Cream Separator Co., Waterloo, Iowa.
12. *The Cleveland Separators* Nos. 0, 1, 2, 3 (models D, E, F, G)	350–800	65–105	The Cleveland Cream Separator Co., Cleveland, O.
13. *Great Western Cream Separators.* Nos. 20, 30, 40, 60, 70, 90	300–900	55–110	Rock Island Plow Co., Rock Island, Ill.
14. *Blue Bell, Dairy Maid,* and *Lily Cream Separators.* Nos. 1, 2, 3, 4—Blue Bell and Dairy Maid.	350–850	....	Internat. Harv. Co. of America, Chicago, Ill.
Nos. 1, 2, 3, 4, 5—Lily	350–1050	....	
15. *New Improved Golden Harvest Separator.* 4 styles	350–900	29.80–47.00	Montgomery Ward & Co., Chicago, Ill.
16. *Economy Chief Separators.* 3 styles	250–600	27.65–42.35	Sears, Roebuck, & Co., Chicago, Ill.
17. *The King Sanitary Cream Separators*..... Nos. 2, 4, 6, 8	250-800	24.95–48.80	King Separator Wks., Buffalo, N. Y.
18. *Wisconsin Dairy Cream Separators.* Nos. 3, 4, 5, 6, 7—Gearless Victory	350–900	40–75	Starch Bros. Co., La Crosse, Wis.
19. *The Milwaukee Cream Separators.* 3 styles	500–900	50–60	The Milwaukee Separator Co., Milwaukee, Wis.
20. *The Standard Cream Separators.* Nos. 3, 5, 6, 9, 12—Champion Hand Crank	350–1200	65-110	Standard Separator Co., Milwaukee, Wis.
Automatic gasoline engine and cream separator combined	738	125	
21. *The Beatrice Cream Separators.* Nos. 42, 47, 52	550–1000	55–75	Beatrice Creamery Co., Lincoln, Neb.
22. *Anker-Holth Self Balancing Separators.* Nos. 3, 5, 7, 9	300–900	55–105	Anker-Holth Mfg. Co., Port Huron, Mich.

LIST OF HAND AND POWER CREAM SEPARATORS.

(*Continued.*)

Name.	Capacity per Hour.	Retail Price.	Manufacturer or Agency.
23. *The Galloway Cream Separators.*	Lbs.		
Nos. 1, 2, 10, 14, 16, 18	200–1200	29.75–91.00	The Wm. Galloway Co., Waterloo, Ia.
B. POWER SEPARATORS.			
1. *De Laval Separators.*			The De Laval Separator Co., New York.
"Alpha" Nos. 1, 2, Belt	3500–5000	500–750	
"Alpha" Nos. 1, 2, Turbine	3500–5000	525–800	
"Alpha" Acme Belt	2000	350	
"Alpha" Acme Turbine	2000	375	
Standard Belt	1300	250	
Standard Turbine	1300	275	
Centrifugal Milk Clarifier, Belt. Nos. 115, 120	8–12,000		
Centrifugal Milk Clarifier, Turbine	8–12,000		
2. *U. S. Cream Separators.*			Vt. Farm Machine Co., Bellows Falls, Vt.
Nos. 12, 14, 15—Turbine	750–1350	110–150	
Nos. 1, 0—Turbine	2300–3000	....	
Nos. 1, 0—Belt	2300–3000	....	
3. *Tubular Cream Separators*			The Sharples Separator Co., West Chester, Pa.
Nos. 16, 26, 32, 40—Turbine	1500–4200	200–360	
Nos. 15, 25, 33, 41—Belt	1500–4200	200–360	
4. "*Simplex*" *Separators.*			D. H. Barrell & Co., Little Falls, N. Y.
Nos. 2½, 3, 4—Turbine	1200–3500	200–500	
Nos. 2½, 3, 4—Belt	1200–3500	225–500	
Nos. 7, 9, 11—Dairy Turbine	700–1100	110–130	
Milk Clarifier, Belt or Turbine	12000	500	
Whey Separator, Belt or Turbine (2 sizes)	3500–4500	350–500	
5. *Victory Cream Separator.*	800	85	Starch Bros., La Crosse, Wis.

FORMULAS FOR FINDING THE FAT CONTENT OF CREAM.

Fleischmann's formula:

$$\text{Per cent fat in cream} = f_2 = \frac{100(f-f_1)}{R} + f_1,$$

where R = per cent of cream obtained, f = per cent fat in milk, f_1 = per cent fat in skim-milk; or

$$f_2 = \frac{100F}{AR} \cdot B,$$

where F = per cent of fat in butter, B = yield of butter from 100 lbs. of milk, A = percentage churning. Under ordinary conditions of creaming these formulas may be simplified to

$$f_2 = 6.67f - 1.42, \quad \text{and} \quad f_2 = 5.77B.$$

Formula for finding the per cent cream to be separated when a certain fat content in the cream is wanted (Fleischmann):

$$x = \frac{100(f - f_1)}{f_2 - f_1};$$

f, f_1, and f_2 = per cent of fat in full milk, skim-milk, and cream, respectively.

Formula for diluting cream to a desired fat content:

$$\text{Separator skim-milk to be added} = x = \frac{c \times f_1}{f_2} - c,$$

c being the pounds of original cream of a fat content of f_1, and f_2 the fat content wanted in the cream.

HANDLING AND CARE OF CREAM SEPARATORS.

By J. D. FREDERIKSEN, Little Falls, N. Y., Manager Chr. Hansen's Laboratory.

In selecting a separator, local conditions, space at disposal, nearness to its manufacturer who can put it up, be held responsible, and quickly attend to repairs, etc., may be of importance, and the following points should be considered:

Thorough Separation. — All manufacturers claim that their machines do perfect work, but they do not always come up to the claims. Under normal conditions *the measure for thoroughness of separation is the contents of butter-fat in the skim-milk as ascertained by the Babcock test.* The best modern separators skim practically absolutely clean, and there is now no excuse for anything but perfect skimming. With normal milk at the proper temperature run into the machine at the rate of the capacity claimed for it, *no separator should leave more than 0.1% of butter-fat in the skim-milk,* which is the smallest percentage that can be ascertained by the Babcock test with accuracy.

The table below gives the grand averages for the percentages of fat found in the trials of a number of the leading separators, conducted at the experiment stations of Delaware, Cornell (N. Y.), Vermont, Pennsylvania, and Wisconsin

PER CENT FAT IN CENTRIFUGAL SKIM-MILK.

Style of Separator.	Averages of Trials at American Experiment Stations.	
	Number of Trials.	Per cent Fat in Skim-milk.
Butter Accumulator	11	.14
Columbia Cream Separator	19	.12
Reid's Impr. Danish Separator	8	.14
Danish-Weston "	3	.10
De Laval Alpha No. 1 "	2	.10
" Alpha Acme "	21	.09
" Alpha Turbine "	51	.09
" Alpha Baby No. 2 Separator.	112	.08
" Alpha Baby No. 3 "	7	.125
" Horizontal Separator	9	.19
Jumbo Separator	4	.21
Sharples Russian Separator	34	.24
" Imperial "	30	.34
U. S. Butter Extractor Sep. No. 1	5	.24
Do. (as separator)	2	.14
U. S. Butter Extr. Sep. No. 2	8	.34
Do. No. 3	10	.21
U. S. Separator No. 1	9	.17
Do. No. 3	21	.10
Do. No. 5	27	.13
Victoria, 30 gal. Separator	25	.22
Do. 70 gal. "	12	.10

With the constant improvement in machines it is not difficult to find separators which will do perfect work.

Simplicity, *durability* and *safety of coustruction* are considerations of vital importance. The separator must be *simple* in construction so as to be easy to handle, to clean, and to oil. It must be *durable*, so that it will need but few repairs, and, first of all, it must be absolutely *safe*. Too many deplorable fatal accidents are already due to bursting separator bowls, and too much stress cannot be laid on the demand that the machine must by strongly built, of first-class material and workmanship, so that accidents are made impossible with reasonably careful handling.

As the pressure on the circumference of the bowl increases with the square of the speed, it is evident that the modern high-speed separators are exposed to a tremendous strain —in fact the tensile strain in some of them is as high as 20,000 to 30,000 lbs. to the square inch. Fortunately, the improvements in bearings and other features of construction

which have enabled manufacturers to increase the speed, have caused them at the same time to reduce the diameter of the bowl, which makes the modern machine much safer than the first crude and heavy separators.

Power.—Considering its capacity, a well-built separator requires comparatively little power, whether coal or muscle. But as either is money, it is a matter of importance that none be wasted. Many so-called hand separators are altogether too heavy to run by hand, hence in selecting one see that it is easy to keep it running for several hours. The tests made at the experiment stations by dynamometer, as well as by measuring the steam consumed, show that there is a great deal of steam wasted in a creamery above that actually required to drive the separator; that "the turbines use steam extravagantly, but that the small engine of the creamery uses it still more extravagantly." Due allowance must therefore be made for this waste in comparing results obtained by various methods of testing. The following table gives some of the results published by the stations:

Horse-power per 1000 lbs. Milk.

Style of Separator.	Delaware.	New York.	Vermont.	Wisconsin.
Butter Accumulator	....	2.69	....	2.45
Columbia Cream Separator	....	3.17	....	
Reid's Improved Danish	....	....	1.83	1.52
De Laval Standard	....	....	......	2.12
" Alpha No. 1	....	....	......	0.81
" Alpha Acme	....	....	0.79	0.98
" Baby No. 2	0.37	....	....	0.46
" " No. 3	....	0.26	......	
Jumbo	....	....	1.87	
United States No. 1	....	....	1.37	1.12
" No. 3	....	0.76	......	0.63
" No. 5	....	....	....	0.72
Victoria, 700 lbs	......	2.78	....	
" 30 gals	0.74	......	....	
" 20 gals	0.85	....	....	
De Laval Alpha Turbine	....	....	....	1.47 to 1.79
Sharples Imperial	....	....	....	1.42
" Russian	......	....	....	1.75 to 2.11

These tests are made with single machines and do not guarantee that all separators of the same makes consume

the same power or steam. The accumulating results of such trials being compiled, however, become a guide in estimating the value of the various machines in the market. As between belt and turbine (or direct steam) power, the former is preferable in large creameries. In small plants one is about as economical as the other, and the choice may depend upon whether an engine is needed for churning, butter-worker, pump, and other purposes, or you can do without it.

Capacity.—In selecting a separator it is best to have plenty of capacity. In a large creamery it is better to have two separators of moderate size than one very large machine. Only in very large creameries may separators of largest capacity be preferable. The capacity should be such as to finish the day's work in 4 to 6 hours at the time when there is most milk. In the private dairy, using a hand separator, the work should require only one hour, rather less. The following would be our idea of the proper capacity:

Largest Supply of Milk per Day, lbs.	Number of Machines.	Capacity of Each Machine, lbs. per hour.	Power.
15,000 or more	2 or more	2,000 to 2,500	Engine
10,000 to 15,000...........	2	1,500 " 2,000	"
7,500 " 10,000...........	2	1,200 " 1,500	"
5,000 " 7,500...........	2	1,000	Eng. or Turb.
2,500 " 5,000...........	1	1,200	" "
1,000 " 2,500.	1	600 to 1,000	" "
500 " 1,000...........	1	600	Sheep, or dog, or turbine.
300 " 500.	1	300 to 500	Hand, or dog, or sheep.
100 " 300...........	1	300	Hand
Less than 100...	1	150	"

Condition of Cream.—As discharged from the separator, the cream should be smooth and even, free from froth and of perfect "churnability."

As to *cost*, *the best machine is always the cheapest* in the long run. Repairs, waste of fat in the skim-milk, of oil, and of coal, by an inferior machine, will more than make up any saving in first cost.

Running the Separator.

The Operator should understand his Business.—He should have thorough training in creameries as a helper and, if possible, in a dairy school, before undertaking to manage a creamery separator on his own responsibility. A new machine should be put up and started by the manufacturer or his agent, and prove in perfect shape and efficiency before he leaves. Every manufacturer gives detailed instructions as to the care of the separator, and such an instruction book should always be at hand. The operator of hand as well as of power machines should make himself familiar with every detail of the construction.

Condition and Temperature of the Milk.—*Fresh and warm from the cow*, the milk is in the best condition to be skimmed. If it cannot be had in that condition, it should be aerated and *cooled* on the farm, so that it arrives at the creamery or the dairy at not over 60°. Then reheat it to 80° or 85°, not under 75° and not over 90°. This heating is preferably done in some continuous heater, as it is dangerous to heat it in bulk, because milk standing some time at 85° is apt to spoil. While the separator will skim at a lower temperature, either the skimming is not clean or less milk must be run through the machine in the same time. Of course, the milk must be sweet.

Starting.—*Oil all bearings thoroughly, using only the very best oil.* Ascertain that everything is in trim order, then start according to instructions, which vary for different kinds of machines. Always start carefully, and where the belt from the intermediate is shifted from loose to fixed pulley, do it slowly and gradually, helping with the hand on the belt to start the bowl. When the bowl appears to be running at full speed without shaking, ascertain if it really does so by means of the *speed indicator*, which should always be found on any power machine.

Never allow the machine to run faster than permitted by the manufacturer. If you do, it is at your risk and at the risk of the lives of your assistants. Use the speed indicator often.

See that the feed of new milk is correct and that the *proportion of cream* to milk is as wanted. Hold a quart measure under the skim-milk spout and a measuring glass under the cream outlet, and, when the quart measure is full, see how much cream you have in the measuring glass, taking the time by your watch. If you have 6 ozs. of cream to 1 quart of skim-milk in 9 seconds, you have taken 6 parts of cream from 38 of new milk, or a little less than one sixth, or about 16%, and you are running at the rate of 950 lbs. per hour. How large a proportion of cream to take from the milk depends upon the richness of the milk and the consistency of cream desired. If you have 4% milk and you wish cream of 28% fat, you will take 1 part of cream from 7 of new milk, or 14% .

Keep the oil-cups filled and look frequently at all working parts of the machinery. Well started and regulated, it will run uninterrupted until all the milk is skimmed. When the last milk has entered the bowl, pour in sufficient skim-milk to crowd out all the cream left. If the skim-milk is removed from the building while the separator is running, *take samples frequently*, or, if it is all left after the work is done, take a few average samples to *test with the Babcock machine, so as to control the day's work.*

Stop the machine cautiously, removing the motive power and letting the bowl come to a stand-still of itself *without applying any brake.* Remove the skim-milk left in the bowl by a siphon or otherwise, take off the covers, etc., and lift out the bowl.

Cleaning.—First rinse the bowl and other parts which have been in contact with milk in cold or tepid water, and then scrub them in boiling water, frequently using some solution of sal-soda. Scrub and brush every corner. Rinse in clean boiling water and steam out the tin covers, etc. Wipe with a cloth and set the things to dry. Pump out every pipe that cannot be reached by hand and brush. If possible, *avoid the use of rubber hose* to conduct the milk from the vat or heater to the separator, but use open tin conductors or short tin pipes, which can be easily kept clean. Rubber hose cannot be washed in boiling water

or soda, and is a source of contamination. Clean the separator stand carefully with a cloth and wipe the spindles, etc. Occasionally *clean out the oil-chambers* with kerosene oil, and always see to it that no gum is formed and that the *oil-grooves and tubes* are open.

If the separator shakes, or in any way works imperfectly, find the cause without delay and remedy it. If you fail to find the fault, or you cannot remedy it yourself, notify the manufacturer or his agent, and have him attend to it at once.

Treatment of the Cream.—As the cream leaves the separator, it should at once be cooled to 50° or lower. This insures "body" in the butter, and should not be neglected, at least not unless the cream is thoroughly chilled after it is ripened, before churning.

LOSS OF BUTTER CAUSED BY INEFFICIENT SKIMMING.

If three-tenths of one per cent of fat is left in the skim-milk, instead of two-tenths, in a separator creamery receiving 1000 lbs. of milk a day, there will be a loss of about 340 lbs. of butter for the whole year, on the supposition that 1000 lbs. of milk yield 800 lbs. of skim-milk, and 1 lb. of butter contains .86 lbs. of fat. If the separation is still poorer, greater losses will be sustained, as will be seen in the table given below. (Friis.)

Lbs. of Milk per Day.	Excess of Fat Left in Skim-milk.			
	.05 per cent.	.10 per cent.	.20 per cent.	.30 per cent.
	Loss of Butter During Whole Year.			
1,000	170	340	680	1,020
2,000	340	680	1360	2,040
3,000	510	1020	2040	3,060
4,000	680	1360	2720	4,089
5,000	850	1700	3400	5,100
6,000	1020	2040	4080	6,120
7,000	1190	2380	4760	7,140
8,000	1360	2729	5440	8,160
9,000	1530	3060	6120	9,180
10,000	1700	3400	6800	10,200

STANDARDIZATION OF CREAM. (Erf.)

Percentage Quantity of Cream of a Desired Fat Content made from Cream of a Certain Fat Content by Diluting with Milk Containing 4 Per Cent of Butter Fat.

Per Cent Fat in Cream on Hand.	Cream of Desired Fat Content.					
	17	20	22	25	27	30
18	92.857	....	....	....	....	....
19	86.666	....	....	....	....	....
20	81.250	100	....	....	....	....
21	76.4706	94.706	....	....	....	....
22	72.2222	88.8888	100	....	....	....
23	68.4222	84.2222	94.2125	....	....	....
24	65.0000	80.0000	90.0000	....	....	....
25	61.905	76.1905	85.7143	100	....	....
26	59.0909	72.7272	81.8181	95.4545	....	....
27	56.5217	69.5651	78.2608	91.3044	100	....
28	54.1666	66.6666	75.0000	87.5000	95.8333	....
29	52.0000	64.0000	72.0000	84.0000	92.0000	....
30	50.0000	61.5385	69.2308	80.3461	88.4615	100.00

If cream is to be standardized with 4 per cent milk, the result found by the intersecting columns represents the pounds per hundred, or the per cent of the quantity which is cream of the per cent fat on hand.

Example.—If cream containing 20 per cent of butter fat is desired, and cream containing 26 per cent of fat is on hand, then 72.7 per cent of the quantity desired must be cream containing 26 per cent of fat, and 27.3 per cent of the quantity must be 4 per cent milk. (See Ill. Bull. No. 75; also p. 272.)

STEAM BOILER AND ENGINE MANAGEMENT.

By Prof. A. W. Richter, of the University of Montana.

Boiler.

Feed Apparatus.—Every boiler should be provided with a check-valve, placed between the feed apparatus and boiler, and in such a manner as to have the weight of the valve assist in closing it. Between this check-valve and boiler there should be an additional globe or gate-valve which may be closed, thus permitting repairing or cleaning of the check-valve while the boiler is in operation.

Water Supply.—Feed-water should enter a boiler in such a manner that the plates do not receive the direct impact of cold water. The usual practice is to have the feed enter through the blow-off pipe, thus preventing this pipe from clogging. The feed supply should be regulated so as to keep the water level as stationary as possible, The greatest care must be taken that the water level does not fall below the top of the flues. Neglect in this direction will cause the metal to become overheated and consequently weakened, causing leakage of joints and in-

creased wear and tear, but more often resulting in an explosion of a more or less serious nature.

Water-glass and Water-gauges.—Every boiler should have three water-gauges in addition to a water-glass; these are usually attached to a hollow cast-iron cylinder or tube connected with the water and steam spaces.

The water-glass should be blown out daily, and, if clogged, can be safely cleaned with a bent wire.

In no case should the water glass alone be depended upon to indicate the water level.

Steam-gauge.—Each boiler should be provided with a steam-gauge, which gauge should be directly connected with it.

Safety-valve.—Every boiler should be provided with a safety-valve having direct communication with the steam space, and there should, moreover, be an intervening valve. Some of the most disastrous explosions can be traced to faulty arrangement in this respect. The valve thoughtlessly left closed after cleaning or repairs prevents the safety-valve from relieving the pressure when it rises above the safe working pressure of the boiler.

Safety-valves are of two kinds: spring and lever safety-valves. Of the two valves the lever-valve has the most disadvantages, one of the most important being the ease with which it may be made useless by adding an additional weight to that already provided, in order to keep the valve on its seat, and therefore greatly increasing the pressure at which it will blow off.

A safety-valve should be raised each day by hand so as to allow steam to escape; this prevents clogging and rusting.

The dealer will usually set the spring-valve so that it will blow off at the desired pressure. It can be adjusted, however, by loosening or tightening a screw provided for that purpose.

The lever-valve may be set with the aid of the following formula:

$$l = \frac{bPA - Vb - wc}{W};$$

l = distance from weight to fulcrum;

b = " " valve centre to fulcrum;

c = distance from the centre of gravity of the lever of the fulcrum;

P = boiler pressure;
A = area of valve;
V = weight of valve;
w = " " lever,
W = weight hung upon the lever.

Firing.—Firing should be gradual, and the grate kept completely covered with coal or ashes. The fire should not be more than four or five inches deep unless the pieces of coal are large, in which case the depth may be increased.

The fire-doors and flue-doors should not be opened in order to keep down the steam pressure. This practice not only wastes fuel but is injurious to the boiler, and will not be necessary if the boiler is properly attended to.

Priming or Foaming.—Foaming is a rapid disturbance of the water, in consequence of which it rises in the boiler in the form of spray or foam; it is usually caused by dirty water, presence of oil, etc., the boiler not having been cleaned for some time or not thoroughly cleaned. Foaming may, however, be due to other causes, such as too small a steam space, sudden demand of a great quantity of steam, etc. In case a boiler foams all steam connections should be shut off and the fire dampened by means of a fresh supply of live coal or ashes. These precautions will usually suffice to allow the water to settle, and to enable one to ascertain the true water level. If the glass shows a small amount of water, start the pump or injector, and fill the boiler to a point between the second and third gauge. The boiler may then be blown off to the first gauge by means of the surface blow-off, if one be present, and if not present the regular blow-off valve may be used. This operation being repeated, the impurities are gradually diminished, but care must be taken that the water level does not fall below the top of the flues. The boiler can now be used as before, but in all cases it should be thoroughly cleaned as soon as possible.

Removal of Scale.—Potatoes, about eight or ten in number, are sometimes placed in the boiler after cleaning. Soda or kerosene may also be injected with the feed-water in quantity to be determined by observation. Boiler compounds should be used with caution, and when used should be obtained from a reliable dealer. Too great a quantity of any of the above will be harmful.

Cleaning.—The interval during which a boiler requires no cleaning depends upon the quantity and the quality of water evaporated. Under usual conditions, in order to obtain the best results, a boiler should be cleaned every six or eight weeks.

If a boiler is to be cleaned it should be allowed to stand until it is partially cooled off. When blown out cold the metal in the interior will usually be found covered with a thick coating of soft deposit, which can easily be scraped off or washed off with a hose and stream of water.

If a boiler be blown off while the metal is at a high temperature, the deposited matter is usually baked and forms a solid and hard coating, increasing rapidly if not carefully removed by the process of chipping.

Boiler Power.—The manner in which the horse-power of a boiler is usually calculated is far from satisfactory, depending rather upon its size than its power of evaporation.

In 1884 the American Society of Mechanical Engineers adopted the following definite standard:

"A horse-power shall be equivalent to an evaporation of thirty pounds of water into dry steam per hour from feed-water at 100° Fahrenheit, and under a pressure of 70 lbs. per square inch above the atmosphere."

Steam-engine.—The engine should be provided with a governor to regulate its speed, a lubricator to oil valve and piston, and a sufficient number of oil cups, so that all bearings may be properly oiled.

Starting the Engine.—Before starting, all bearings should be supplied with oil, and all waste pipes connected with cylinder and steam-chest opened. The engine should then be started slowly, so as to allow the water to escape. A quantity of steam will always condense as it comes in contact with the cold cylinder-walls, in addition to the water already present in the steam-pipe. This water does not pass off as readily as steam, neither can it be compressed to any great extent. Therefore, if more water be present in the cylinder than will fill the clearance space, and this water not be allowed to escape, the piston moving towards the end of its stroke will strike the water, and consequently be compelled to stop. The greater the speed of the piston as it advances, the greater the force with which it strikes the water, resulting in many cases in a broken cylinder head.

It is well to have a waste-pipe connected to the steam-pipe at a point just above the engine-valve, in order that the water which has collected in the steam pipe may be blown out before opening the steam-valve.

After the engine has been in operation for a minute or two the waste-valves should be closed.

Horse-power.—The horse-power of an engine may be calculated by means of the following formula:

$$\text{H. P.} = \frac{PLan}{33000};$$

H. P. = horse power;
P = mean effective pressure in the cylinder;
L = twice the length of the stroke, in feet;
a = area of piston in square inches;
n = number of revolutions per minute.

ON THE PRESERVATION OF MILK AND CREAM BY HEAT.

By Dr. H. L. Russell, of Wisconsin Experiment Station, Author of "Dairy Bacteriology".

On account of the innumerable bacteria that gain access to milk during the process of milking, and subsequent to that time, and the rapid increase of the same in this nutritious fluid, this material universally undergoes fermentative changes, the rapidity of which is largely dependent upon the surrounding temperature. To increase the keeping quality of milk, it is necessary to annihilate these bacteria or keep them under influences unfavorable to their growth.

Heat has been found to be the most efficacious agent in preserving milk in its natural condition. It is applied in two ways, viz., 1. *Pasteurization*, where the milk or cream is heated for a short time (20–30 min.) at a temperature near the coagulating point of the proteid constituents of the milk (150°–160° F.). 2. *Sterilization*, where the temperature approximates or exceeds the boiling-point and is applied for a longer time.

The object in both cases is to kill the bacteria present in the milk.

Sterilization accomplishes this most successfully, but it changes the proteid compounds so that the milk has an undesirable "cooked" flavor and odor.

This defect is not found in pasteurized milk, and if properly handled, milk treated by this process will remain sweet from 4 to 8 days.

For use in the near future the pasteurized product is, on the whole, the most satisfactory; the sterilized material being best adapted for export purposes.

The essential condition in pasteurization is that the pasteurizing temperature shall exceed the thermal death point (the temperature at which growing bacteria are destroyed) of disease-producing as well as fermentative bacteria. This temperature for most forms is about 140° F., but certain disease organisms like the tubercle germ of tuberculosis is not killed below 149° F. for 30 minutes, or 155° F. for 15 minutes. As this germ is often found in milk from tuberculous cows, prudence dictates the use of this temperature as a standard for the pasteurization of milk and cream. The proteids in the milk are slightly affected at this temperature, but if the milk is thoroughly chilled, the "cooked" flavor disappears.

The application of this temperature kills only the growing bacteria, and does not affect the latent spores. If after being heated the milk is allowed to cool slowly, and is left at a comparatively warm temperature (exceeding 55° F.), these spores germinate and soon change the character of the milk, so that the value of the heating process is lost. To be efficient, it is necessary to *rapidly* cool the pasteurized product below the germinating point of the spores, for if they are once allowed to sprout, they will develop slowly at a very low temperature.

In pasteurizing milk or cream, the apparatus should be constructed so that a definite quantity of the fluid can be held at any desired temperature for any length of time, and during the process protected from infection from the air. The apparatus must also be made so as to be easily cleaned and thoroughly sterilized by steam throughout. The milk must be protected from air infection during its withdrawal from the pasteurizing vat into storage vessels (cans and

bottles), and should be thoroughly chilled in a refrigerator for several hours (better over night) before being delivered to the consumer. This chilling process should succeed the heating operation as quickly as possible, as the sudden transition in temperature from 155° F. to 55° F. or less has a paralyzing effect on the development of those organisms (spores) that are not killed by the heat. The machines that have been put on the market have for the most part been designed primarily from the dairyman's standpoint, and while they fulfill their requirements as to capacity, cheapness, etc., yet they cannot in general be relied upon to treat the milk in a way so as to free it with certainty from all possible disease-producing bacteria. The Potts' Pasteurizer, which has been sold quite extensively in this country during late years, may, however, be considered an entirely satisfactory and practical machine.

Pasteurization in this country is applied with great success to milk and cream where these products are used in the liquid form. It is used to some extent in this country, but much more widely in continental Europe, in the preparation of cream for the manufacture of butter by the use of a pure culture-starter. It can also be used advantageously in the hot months for increasing the length of time that by-products of the factory like skim-milk and whey may be preserved.

Pasteurization, as well as sterilization, reduces the body, consistency, of milk and cream, and these products therefore seem thinner after having been subjected to the process of heating than before. To obviate this, Dr. Babcock and the writer in 1896 recommended the addition of a small quantity of a solution of sucrate of lime ("viscogen") to the milk or cream, which will restore the consistency of the products, and in case of cream, greatly increase its whipping quality. (See Bull. No. 54 or thirteenth report of Wisconsin Experiment Station.)

DIRECTIONS FOR THE STERILIZATION OF MILK.

(U. S. Dept. of Agriculture.)

The sterilization of milk for children, now quite extensively practised in order to destroy the injurious germs which it may contain, can be satisfactorily accomplished with very simple apparatus. The vessel containing the milk, which may be the bottle from which it is to be used or any other suitable vessel, is placed inside of a larger vessel of metal, which contains the water. If a bottle, it is plugged with absorbent cotton, if this is at hand, or in its absence, other clean cotton will answer. A small fruit-jar loosely covered may be used instead of a bottle. The requirements are simply that the interior vessel shall be raised about half an inch above the bottom of the other, and that the water shall reach nearly or quite as high as the milk. The apparatus is then heated on a range or stove until the water reaches a temperature of 155 degrees Fahrenheit, when it is removed from the heat and kept tightly covered for half an hour. The milk-bottles are then taken out and kept in a cool place. The milk may be used any time within twenty-four hours. A temperature of 150 degrees maintained for half an hour is sufficient to destroy any germs likely to be present in the milk, and it is found in practice that raising the temperature to 155 degrees and then allowing it to stand in the heated water for half an hour insures the proper temperature for the required time. The temperature should not be raised above 155 degrees, otherwise the taste and quality of the milk will be impaired.

The simplest plan is to take a tin pail and invert a perforated tin pie-plate in the bottom, or have made for it a removable false bottom perforated with holes and having legs half an inch high to allow circulation of the water. The milk-bottle is set on this false bottom, and sufficient water is put into the pail to reach the level of the surface of the milk in the bottle. A hole may be punched in the cover of the pail, a cork inserted, and a chemical thermometer put through the cork, so that the bulb dips into the water. The temperature can thus be watched without re-

moving the cover. If preferred an ordinary dairy thermometer may be used and the temperature tested from time to time by removing the lid. This is very easily arranged, and is just as satisfactory as the patented apparatus sold for the same purpose.

QUANTITY OF WATER OR ICE REQUIRED FOR COOLING MILK OR CREAM. (MARTINY.)

The quantity of water or ice required to cool milk or cream may be calculated from the following formulas, where

M = quantity of milk or cream to be cooled, in lbs.
t = its temperature.
W = quantity of water required for cooling, in lbs.
I = " " ice " " " " "
t' = temperature of water or ice at beginning.
T = end temperature of cooled milk or cream.
τ = end temperature of cooling water.
S = specific heat of milk (.95*) or of cream (.92*).
79.25 = latent heat of water.

(*a*) *Water required for cooling milk or cream*—

1. Cooled in tin cans holding milk or cream to be cooled:

$$W = \frac{(Mt - MT)S}{T - t'}$$

2. By application of coolers and running water:

$$W = \frac{(Mt - MT)S}{\tau - t'}$$

(*b*) *Ice required for cooling milk or cream*—

$$I = \frac{(Mt - MT)S}{T + t' \times 79.25}$$

In these formulas the influence of the surrounding air is not considered.

* Figures subject to variations; in practice the sp. heat of both milk and cream may be assumed = 1.—W.

IV. BUTTER.

BUTTER-MAKING.

By H. B. Gurler, ex-President Ill. State Dairymen's Assn., Author of "The Farm Dairy."

Butter is made from milk. The cow manufactures the milk from the food she eats, hence the necessity of sound food. Unsound food makes off-flavored milk and poor butter. Some cows can manufacture food into milk at a profit, others cannot; hence the necessity of knowing the individuality of each cow, or her ability to work at a profit to her owner.

At this stage of the dairy work there is no excuse for a dairyman not knowing what each and every cow is doing for him, thus being able to "weed out" the unprofitable ones.

Be careful and cleanly in milking. Remove the milk to a pure atmosphere as soon as drawn from the cows. If the cream is raised by gravity process be careful of the surroundings, as milk will absorb bad odors from decayed vegetables, the hog-pen, the cow-yard, the kerosene-can, a filthy stable, from cooking in the kitchen, and various other sources.

When milk is put through the separator as soon as it is drawn from the cow this source of danger is removed. Cream from the separator should be cooled immediately to a temperature of 60°; 55° is better. A cooler that will ærate at the same time it is cooling is very desirable. This is a vital point which many butter-makers stumble over. When through separating and cooling, temper the cream to the temperature necessary to have it ripen at the time you wish to churn. If it is to be churned the following day this temperature should be 65°–70°. If the second day, 55°–60°; and if it is to stand four to seven days, cool to 40°, if possi-

ble, as soon as practicable, and hold at that temperature until the day before you wish to churn, when it should be warmed to a temperature that will give the right acidity by the time you wish to churn. This temperature will depend on the kind of cream, whether separator cream or cream from some gravity process. Cream from shallow setting may be sufficiently ripened when taken from the milk. I recommend the use of Prof. Farrington's acid tablets for testing the acidity of cream (see p. 270). They are a great help to a beginner.

Churn at as low a temperature as you can. This will depend on the per cent of fat in the cream. Rich cream can be churned at a much lower temperature than cream poor in fat. Cream from deep, cold setting may be churned at 58° to 62°; and thick, rich cream from shallow setting at a much lower temperature. An ironclad rule cannot be made that will fit all cases. The separator will give cream containing various per cent of fat, from 15 to 40 per cent. Separator cream containing 15 per cent fat will need to be churned at about the same temperature as deep, cold setting cream. Separator cream containing 40 per cent can be churned at a temperature of 50°, can be gathered at 50°, so the buttermilk will draw at that temperature. A low temperature gives the most exhaustive churning. At this temperature the buttermilk should contain no more fat than the average separator skim-milk. Cream containing a large per cent of fat does not develop acid as fast as cream with more milk in it. Cool cream for churning about two hours before, so as to let the butter-fat have time to solidify or harden. This gives a more waxy texture to the butter.

Stop the churn when the butter granules are the size of wheat. If the granules are too small there is danger of a loss from its passing through the strainer. Wash no more than is necessary to remove the buttermilk. The colder it is churned the less washing is needed. When butter gathers at 54° one washing is sufficient; if at 62° to 64°, two or three washings will be needed. Washing removes some of the delicate flavor or aroma. Remove the water from the churn as soon as possible—as soon as it has done its

work. Never allow it to lie and soak unless there is no other way of hardening the butter to a temperature where you can handle it.

Salt to suit your trade. Work once or twice, as you prefer; twice working is preferable, as it makes the nicer-appearing butter. Work just enough to remove the mottled or streaked appearance. When worked twice this can be told at the time by the appearance of the butter. When worked but once it cannot be told until the butter has stood long enough for the salt to dissolve. If worked but once examine the butter the following day, until you make yourself a rule of thumb to work by. I have found this necessary. I am compelled to look after this point in my creamery work when the butter is worked but once. Use the kind of butter-package that suits your trade, but always let it be *neat.* Never send a mussy-looking package to market. You cannot afford to do it.

ON THE USE OF PURE CULTURES IN BUTTER- AND CHEESE-MAKING.

The ripening of cream is brought about through the action of minute plants, so-called bacteria. These are practically omnipresent where man lives, and get into the milk during the milking and the handling of the milk and cream in the dairy. They multiply enormously in the cream during the ripening process, owing to the very favorable conditions of life which they find there. Some forms of bacteria are desirable and even essential in the manufacture of sour-cream butter; these feed largely on the milk-sugar of the cream, and decompose this component into lactic acid, which is the characteristic acid of sour cream (as well as of sour milk). Along with this formation of lactic acid in the cream other complicated, and yet but little understood, decomposition processes take place, the results of which show themselves in the fine aromatic flavor of the butter produced. Other forms of bacteria cause obnoxious fermentations in the cream, and produce a butter of "off" flavor, in aggravated cases making the product unfit to eat or at least unsalable as a first-class article. The

process of sour-cream butter-making is therefore, at the bottom, a question of keeping the fermentations during the ripening of the cream in the right track, of controlling the same so as to exclude all but lactic-acid-producing bacteria. The old original way of reaching this end was to allow the cream to sour spontaneously, trusting to luck to obtain the desired fermentation of the cream by leaving it standing in a warm room for a couple of days. Later on, a buttermilk starter from a preceding churning or a skim-milk starter was added for the purpose of ripening the cream ; by this means the lactic-acid bacteria contained in the starter were introduced in such large numbers that they generally were able to crowd out other kinds of bacteria that might be found in the cream, and which, if left alone, would produce undesirable fermentations in the cream and bad flavor in the butter. The next step in advance was the introduction of pure cultures of lactic-acid bacteria; these consist of one or a few forms of bacteria, and when introduced in milk or cream will be apt to overpower all other forms of bacteria therein, and thus produce the pure mild flavor of sour-cream butter desired.

The honor of having first introduced pure cultures in butter-making belongs to Dr. V. Storch, the chemist of the Danish state experiment station in Copenhagen; the bulletin describing Dr. Storch's investigations of this subject, "On the Ripening of Cream," was published in 1890. Other bacteriologists in Europe and in this country have worked along this same line, and as a result we find that pure cultures are at the present time used almost universally in the manufacture of sour-cream butter in the creameries and dairies of northern Europe, and also in this country their use has become general and is spreading. The expected result of adding a pure culture-starter, viz., that of excluding all undesirable fermentations in the ripening of the cream, will not, however, follow with any certainty unless the seeding with the pure culture is preceded by pasteurization or sterilization of the cream, that is, at least a partial destruction of the bacteria already found therein. In Europe, notably in Denmark and the

other Scandinavian countries, pasteurization of the milk (or of the cream) is practised regularly in all the best creameries, in the former country at present in perhaps 95 per cent of the creameries in operation. In this country the firms manufacturing and selling pure cultures unfortunately did not insist on this point at the start, and where pure culture-starters were used with us it was nearly always without previous pasteurization. One reason why pasteurization has not been generally adopted in the manufacture of butter in this country is that the market demands a higher flavored, "stronger" butter than is wanted by the European market, and the pure cultures on the market, when used with pasteurized cream, do not produce such a butter. The expense of pasteurization of the cream and the absence of proper apparatus, or non-introduction of such as have proved successful in European practice, furthermore tend to explain why our butter-makers do not generally pasteurize the cream in using pure culture-starters. During late years, however, pasteurization of cream has become more general in American creameries.

The five pure cultures now on the market in this country are Chr. Hansen's Lactic Ferment (Chr. Hansen's Laboratory, Little Falls, N. Y.), Ericsson Butter Culture (Elov. Ericsson, St. Paul, Minn.), Flavorone (Parke, Davis & Co., Detroit, Mich.), Elgin Butter Culture (Creamery Pkg. Mfg. Co., Chicago, Ill.), and the Boston Butter Culture (O. Douglas Improved Boston Butter Culture Co., Boston, Mass.). These cultures are placed on the market in dry form as a powder, or in liquid form. Directions for their use accompany each package sold. In general, the method to be followed is to seed the culture in a quantity of sterilized skim-milk or cream; this is kept for one to two days at a temperature below 90°; about 5 per cent. of the starter is then added and mixed with the cream to be ripened; some makers add considerably more than this amount. The cream will be ready for churning the next day. A portion of the starter prepared is used for the seeding of a new lot of sterilized skim-milk which will make the starter for the following day, and the same process is continued until deterioration of the starter sets in, as shown by lack of flavor in the ripened cream and in the butter; a fresh batch is then prepared from a new

package of ferment. If proper care in sterilizing the skim-milk and in handling the starter is taken, the pure culture may be propagated in this manner for months. With lack of cleanliness and care it must be renewed every other week or oftener.

While the use of pure cultures has not as yet become general in American creameries, the agitation caused by their introduction and the discussions in dairy papers and dairy meetings which they have brought about have doubtless been of great benefit to our dairy industry in emphasizing in the minds of butter-makers the necessity of thorough cleanliness in the creamery and the importance of the proper conduct of the ripening process for the manufacture of high-grade butter. They have enabled us to make butter of uniform fine flavor and of greater keeping quality than was previously possible.

Where abnormal fermentations appear, and the butter produced is diseased or "off flavor," the evil may be remedied by the use of pure cultures. In case of the establishment of an export trade of American butter of high quality, the pure cultures used in connection with previous pasteurization of the milk or cream will prove of great benefit, insuring uniform goods and perfect keeping quality in the product.

The use of pure culture-starters in the manufacture of Cheddar cheese is of recent date, and but limited experience has so far been gained in this line. According to the testimony of some of our leading cheese-makers, and of recent experiments conducted at Wisconsin experiment station, their use for this purpose is very beneficial, cheese of improved, clean flavor and high keeping qualities being produced. Pure cultures may therefore be safely recommended for this purpose. The general method of application is similar to that followed in the manufacture of pure culture butter. The starter is propagated in sterilized milk and kept at 90° F. for one day, when it will be slightly lobbered, having an acidity of about .8 per cent. Prof. Decker, late of the Wisconsin Dairy School, gives the following hints on the use of the starter by the cheese-maker:

"The starter is introduced into the milk by rubbing it

through a fine hair sieve so as to break up curd particles. If too large quantities of starter are used, there is a tendency to produce a sour cheese. The best results are obtained when a 2 per cent starter, of the aeidity given, is added.

"In propagating the starter from day to day care must be taken to keep it free from contamination. It should always be prepared in a covered vessel that has previously been sterilized, and the milk used should first be pasteurized (or sterilized) and cooled before adding the 'seed.' Some of the original starter should be taken for 'seed,' not the whole milk after the starter has been added.

"The starter cannot be used for cheese-making if the milk is overripe, which is the case when the rennet test is 65 seconds or under (see p. 282). In sweet milk, testing by the rennet test 120 seconds, the addition of a 2 per cent starter will increase the acidity, so that the rennet test will act in 70 seconds.

"With sweet milk the use of a pure lactic starter will result in the saving of 3-5 hours in time. With tainted milk in which the acid develops imperfectly the addition of the starter aids in producing the acidity required for the manufacture of Cheddar cheese."

BOYD'S PROCESS OF CREAM RIPENING.

By JOHN BOYD, Chicago, Ill.

It is an accepted fact that the fine aromatic flavor and also the keeping properties of butter depend largely upon the treatment of the cream from the time it is separated from the milk until it is ready for the churn, that is, in the best possible condition to yield the maximum quantity and the best quality as to flavor, texture, solidity, etc., free from casein and other undesirable substances. This perfect condition of cream is understood by the term "ripened cream," and when this condition can be produced by the butter-maker with uniformity, regardless of the seasons of the year or extremes of climate, the process may be reckoned as nearly perfect as possible, and not until then. It is most desirable that the process be as sim-

ple as possible, in fact within the reach of every creamery and dairyman in the country, and all the means required to attain these results can and should be a part of every dairy and creamery, large or small.

Boyd's process or system of ripening cream or milk is the result of years of practical work in a private dairy of about 40 Jersey cows. After it had been thoroughly tested and used, during all the seasons of the year, it was patented in the United States, Canada, and Great Britain, and given to the public in the year 1889, a very considerable time in advance of any of the artificial methods of ripening, now being advocated under the representations of "pure cultures of bacteria."

When first introduced it was met by a sea of opposition from the experts, who would see nothing good in it, but gradually it has been making its way in a quiet manner into popularity until at present it is being successfully practised in every state in the Union, and is gaining favor every day with the most practical butter-makers.

The apparatus necessary to practise the process supplies all the conditions required to produce a uniform result every day in the year, the temperature of the lactive ferment and also of the cream being entirely under the control of the operator during the entire process.

The directions for using the process, which go with every purchase of the apparatus, are as follows:

To make the Best Ferment.—Take milk from fresh-milking cows (that from pregnant cows will not answer); submerge the milk warm from the cows in Cooley cans in ice water. Skim at twelve or twenty-four hours, as most convenient, and use this skimmed milk for making the ferment; or select milk as above, run it through a separator, and save the skimmed milk for making the ferment.

The skimmed milk so selected is then brought to a temperature of 90°, in a water bath, being constantly stirred during the operation of heating. As soon as the temperature of the milk reaches 90°, place it in the fermenting-can and close the cover tightly, having first rinsed out the can with warm water. Allow the can to remain closed for

twenty or twenty-four hours, when the ferment will be found thick and in the proper condition for mixing with the cream or milk to be ripened.

How to use the Ferment.—First bring the cream or milk in the vat to a temperature of 66° to 70° Fahrenheit, when the ferment is to be thoroughly mixed with the cream or milk in the proportion of 2 per cent of the ferment to the amount of cream or milk to be ripened. Remove one or two inches of the top of the ferment, which is not desirable to use, and strain the rest through a fine strainer or hair sieve into the milk or cream. The finer the ferment is broken up the more effective its operation will be. After the cream or milk and ferment are well stirred and mixed at the above temperature, the vat must be closed and allowed to remain undisturbed until the cream is ripened, requiring from twenty to twenty-four hours for the operation; the cream when ripe will be found thick, mildly acid, and in the proper chemical condition, requiring only to be cooled to the proper temperature for churning.

Churning.—The best temperature for churning depends so much upon circumstances that the range is very wide, from 55° to 68° Fahrenheit. The richer the cream in butter-fat the colder the temperature should be, and the more milk the cream contains the higher the churning temperature should be. After the cream or milk and ferment are mixed, no more stirring is admissible, as any agitation of the cream afterwards retards the ripening process.

Butter by Shallow-pan Creaming.—Raise the cream in a temperature of about 60° F.; avoid as much as possible skimming milk in with the cream; ripen at about 65° F.; churn at 60° to 62°. Free the granules of butter from the buttermilk by washing in water, temperature about 55°. Salt, 1 oz. to 1 lb. of butter.

Butter by Deep Cold Setting and Cooley System.—Raise the cream in ice-water; milk may be skimmed in with the cream or not as desired; with the Cooley cream a very considerable portion of milk added to the cream will produce no bad effects. Ripen at a temperature of 68° by adding lactive ferment; churn at temperature of 58° to 65°;

wash the granules in water, temperature 50° to 55°, and salt as above.

Butter from Separator Cream.—Cool the cream from separator to 66° to 68°, add lactive ferment, and churn at 55° to 58°, according to the percentage of butter-fat in the cream. The cream should be cooled after ripening so that the temperature of the cream will register not over 55°. This cooling requires time and patience, but will be rewarded with solid granules. Wash in water at 50° to 52°. Salt, 1 oz. to 1 lb. of butter.

Good butter should not contain more than 16% of water (and may contain as little as 8%) when properly worked. It is sufficiently worked when it presents a delicate elasticity to the touch, and when broken should show a perfect uniformity of grain and color.

THE ALKALINE TABLET TEST OF ACIDITY IN MILK OR CREAM.*

By Prof. E. H. Farrington, of Wisconsin Dairy School.

This test is now extensively used by persons interested in either one or all of the dairy products: milk, cream, butter, and cheese. It shows the extent to which acidity has developed in a given sample and gives this information quickly. Briefly stated, it may be used for the following purposes:

First.—For testing the acidity of milk. To detect those lots which are apparently sweet, but too nearly sour for pasteurizing, for retailing, or for making the best butter or cheese.

Second.—For testing the acidity of each lot of cream during its ripening, to trace the progress of its souring, and to show whether the fermentations should be hastened or checked in order to have the cream in a certain acid condition at a given time and ready for churning.

Rapid Method of Testing Many Lots of Milk.—In addi ion to the tablets, the only apparatus necessary for testing the acidity of either milk or cream is a common white teacup, a 4, 6, or 8 oz. bottle, and a No. 10 brass cartridge shell or similar measure. The testing solution is prepared by dissolving one tablet in one ounce of water. This is the standard solution. Four ounces of

* For a more detailed discussion of the alkaline tablet test, see *Farrington-Woll*, Testing Milk and its Products, 2d Ed., pp. 124–131.

the tablet solution are made by filling a four-ounce bottle with water and adding to it four tablets. The No. 10 shell is filled with the milk or cream to be tested. This measured quantity is poured into a white cup. The same measure is then filled with the tablet solution and this is poured into the cup. The two liquids are thoroughly mixed, and the color of the mixture is noted. If there is no change of color, another measure of tablet solution is added. This is continued until the sample which is being tested retains a pink color. As soon as the pink color is obtained no more tablet solution is added. The per cent of acid in the sample tested is found from the number of measures of tablet solution it is necessary to add to one measure of the milk or cream sample in order to produce the pink color. Each measure of tablet solution represents one-tenth of one per cent acid when tests are made in this way.

The Most Delicate Method.—A more exact testing of acidity can be made by using a 17.6-cc. pipette for measuring the milk or cream to be tested and a 100-cc. graduated cylinder for measuring the tablet solution.

Five tablets are dissolved in 97 cc. of water in the cylinder, and this solution is gradually poured into the 17.6 cc. of milk or cream in a white cup. When sufficient tablet solution has been added to produce the pink color in the sample tested, the operator observes on the scale of the graduated cylinder the number of cc. tablet solution used. Each cc. of this tablet solution is equal to 0.0090 gr. lactic acid, and when 17.6 cc. of a sample is tested, each cc. of the tablet solution is equal to .01 per cent acid in the sample. The per cent of acid in each sample is therefore indicated by the amount of tablet solution used in each case.

Milk does not smell or taste sour until it contains about three-tenths of one per cent acid. It has been found, however, that milk containing over two-tenths per cent acid cannot be safely pasteurized, because such milk sours very soon. These tablets supply a quick means of sorting different lots of sweet milk, by showing which contain less and which more than two-tenths of one per cent acid.

Cream is often ripened so far that the quality of the butter is injured. The usual method of the butter-maker for testing

the sourness of the cream is by the sense of smell and taste. A tablet test shows exactly what per cent of acid each lot of cream contains, so that the butter-maker is better able to manufacture a uniform grade of butter by always ripening his cream to the same point before it is churned. Sweet cream contains about 0.15% acid. Cream has reached the proper point for churning when it contains about six-tenths per cent acid. As the souring of cream is largely influenced by the temperature at which it is held, the butter-maker is able to know from an acid test of the cream whether it should be warmed or cooled in order to have it ready for churning at a given time and just sour enough for making butter of good flavor (see page 313).

Cheese-makers are beginning to use this test as a substitute for the hot-iron and other tests, because of the exactness with which it shows the acidity of the milk, the whey, and the curd.

DIRECTIONS FOR THE USE OF MANNS' TEST FOR ASCERTAINING THE ACIDITY OF CREAM.

1. Stir the cream thoroughly; insert small end of pipette in cream and draw until nearly full; then put the finger over upper end of pipette and allow cream to escape slowly (by admitting air) until mark on neck of pipette is reached. Transfer to a tumbler, rinse the pipette three times with lukewarm water, adding the rinsing water to the cream in the tumbler. Now add to contents of the tumbler three drops of the solution marked "Indicator" (phenolphtalein).

2. Fill the burette up to the 0 mark with the solution marked "Neutralizer" (alkali solution).

3. While constantly stirring the cream with the glass rod, allow the liquid to flow from the burette into the tumbler until the entire contents of the tumbler shows a pink tinge. Stop adding the solution from the burette the moment the color is permanent.

4. Read the level of the liquid remaining in the burette. The reading shows the amount of acid present.

The experience of those using the test indicates that where the acidity of the cream is right, to secure the best results in yield and flavor of butter, from 38 to 42 cc. of the neutralizer will be required for the test. It is a simple

matter for each butter maker to learn by experiment the exact degree of acidity and churning temperature suited to the best results, and with these as standards reduce the process of butter-making to a certainty. By testing his cream in the afternoon the butter-maker will be able to set it to ripen at such a temperature that it will show the proper acidity for churning next morning.

In testing the milk for cheese-making the same directions are to be followed, excepting that a much less acid condition is required; probably 15–20 cc. will give the best results. The whole numbers are cubic centimeters; the intermediate divisions are fractions of a cubic centimeter.

Precautions in Using the Test.—The solution marked "Neutralizer" is prepared of a certain strength. It is essential that this strength remain constant. Never let this solution stand without a stopper. Keep in glass or stoneware.

PERCENTAGE COMPOSITION OF BUTTER. (König.)

	Average.	Minimum.	Maximum.	Sweet Cream Butter.	Sour Cream Butter.
No. of analyses included	351	......	......	10	11
Water	13.45	4.15	35.12	12.93	13.08
Fat	83.70	69.96	90.92	84.53	84.26
Casein	.76	.19	4.78	.61	.81
Milk sugar	.50	} .45	1.63	.68	.66
Lactic acid	.12			......	......
Ash	1.59	.02	15.08	1.25	1.19

AVERAGE CHEMICAL COMPOSITION OF SWEET CREAM- AND SOUR CREAM-BUTTER.

(Fleischmann.)

	Made from Sweet Cream, not Salted.		Made from Sour Cream, Salted.	
	Not washed.	Washed.	Not washed.	Washed.
	Per ct.	Per ct.	Per ct.	Per ct.
Water	15.00	15.00	12.00	12.50
Fat	83.47	83.73	84.75	84.62
Casein and albumen	.60	.55	.50	.48
Other organic substances	.80	.60	.55	.40
Ash, or ash and salt	.13	.12	2.20	2.00

ANALYSES OF PREMIUM BUTTERS, FAT-STOCK SHOW, CHICAGO, 1889.—IN PER CENT. (MORROW.)

Description of Samples.	Total Score.*	Water.	Fat.	Curd.	Ash.†
1. Sweepstakes—Creamery, gathered cream	96	9.99	85.41	1.01	3.58
2. " " whole milk	94	12.19	82 66	1.21	3.93
3. " Dairy	93	8.49	86.53	.86	4.12
4. " From a grade cow	95.5	9.71	85.96	1.03	3.29
5. First prize—From a Jersey cow	91	8.99	88.08	.79	2.13
6. " " From a Shorthorn cow	91	12.07	84.79	1.34	1.79
7. " " From an Ayrshire cow	93	9.53	86.53	.81	3 32
8. " " From a Devon cow	87	10.78	86.20	.72	2.29
9. " " From a Holstein cow	92.5	10 56	85.53	.88	3.03
Average	92.5	10.23	85.74	.96	3.05

ANALYSES OF FOREIGN SAMPLES OF BUTTER.

(In Per Cent.)

Country.	No. of Analyses.	Water.	Fat.	Curd.	Ash (Salt).
		A. *Salted Butter.*			
Denmark	55	12.86	83.78	1.21	2.15
Sweden	139	14.13	82.57	.98	2.32
Finland	2	13.05	84.11	1.58	1.26
Netherlands	4	12.97	84.13	1.39	1.51
France	235	13.32	84.48	1.43	.77
Great Britain	322	12.09	84.66	1.14	2.11
Germany	162	13.38	83.70	1.25	1.67
Italy	6	11 52	85.56	1.07	1.86
Australia	59	11.16	85.32	.96	2.56
Canada	207	8.97	84.29	1.44	5.17
United States	473	11.44	84.64	1.02	2.90
		B. *Unsalted Butter.*			
France	58	13.73	85.80	1.39	.08
Germany	86	12.03	85.70	2.15	.12
Great Britain	24	13.43	85 64	.80	.13
Austria	5	14.15	84.14	1.54	.17
Italy	53	13.67	85.08	1.11	.15
Switzerland	14	13.76	84.65	1.55	.04
Australia	2	10.63	87.71	1.38	.28
Average for *salted* butter	1676	11.95	84.27	1.26	2.58
" " *unsalted* butter	242	13.07	85.24	1.57	.12

* The standard of the scale of points in a total of 100 was: Flavor, 45; grain, 30; color, 15; salting, 10.

† Chiefly salt.

COMMERCIAL GRADES OF BUTTER.

(New York Mercantile Exchange.)

EXTRAS.

Shall be composed of the highest grades of butter made in the season when offered under the different classifications; 90 per cent. shall be up to the following standard. The balance shall not grade below Firsts.

Flavor.—Must be fine, sweet, clean, and fresh if of current make, and fine, sweet, and clean, if held.

Body.—Must be firm, smooth, and uniform.

Color.—A light straw shade, even and uniform.

Salt.—Medium salted.

Package.—Good, uniform, and clean.

Score.—Shall average 93 points, or higher.

FIRSTS.

Shall be a grade just below Extras, and must be fine butter for the season when made and offered under the different classifications, and up to the following standard:

Flavor.—Must be good, sweet, clean, and fresh if of current make, and good, sweet, and clean, if held.

Body.—Good and uniform.

Color.—Reasonably uniform. Neither too high nor too light.

Salt.—Medium salted.

Package.—Good and uniform.

Score.—Shall average 87 points, or higher.

SECONDS.

Shall be a grade just below Firsts and must be good for the season when offered under the different classifications and up to the following standard:

Flavor.—Must be reasonably good and sweet.

Body.—If creamery or dairy, must be solid boring. If factory or renovated, must be 90 per cent. solid boring.

Color.—Fairly uniform.

Salt.—May be high, medium, or light salted.

Package.—Good and uniform.

Score.—Shall average 80 points, or higher.

THIRDS.

Shall be a grade just below Seconds.

Flavor.—Must be reasonably good; may be strong on tops and sides.

Body.—Fair boring, if creamery or dairy, and at least 50 per cent. boring a full trier, if factory or renovated.

Color.—May be irregular.

Salt.—High, light, or irregular.

Package.—Fairly uniform.

Score.—Shall average 75 points, or higher.

FOURTHS.

Shall be a grade just below thirds, and may consist of promiscuous lots.

Flavor.—May be off flavored, and strong on tops and sides.

Body.—Not required to draw a full trier.

Color.—May be irregular.

Salt.—High, light, or irregular.

Package.—Any kind of package mentioned at time of sale.

PACKING STOCK.

No. 1—Shall be original butter, without additional moisture or salt, sweet and sound, packed in large, new barrels, having a wooden head in each end, or in new tubs, both to be parchment-paper lined, or a good uniform second-hand barrel having a wooden head in each end and parchment-paper lined. Barrels and tubs to be packed full.

No. 2—Shall be original butter, without additional salt or water, sweet and sound, and can be packed in promiscuous or different kind of barrels, tubs, or tierces, without being parchment-paper lined, and may be packed in either two-headed or cloth-covered barrels.

No. 3.—Shall be of any grade or quality above grease, and packed in any and all kinds of packages.

Charges for inspection shall be the same as the rules call for on other grades.

GREASE.

Shall consist of all grades of butter below FOURTHS, free from adulteration.

FORMULA FOR CALCULATING THE YIELD OF BUTTER.

In ordinary dairy or creamery practice, where modern methods of creaming and churning are applied, the yield of butter will exceed that of fat in the milk by 12 to 15 per cent, or 1 pound of fat in the milk will produce about 1.15 pounds butter, i.e., yield of butter from 100 lbs. of milk = $1.15f$, f being the per cent of fat in the milk.

Fleischmann's formula:

$$\text{Yield of butter} = 1.16f - .25$$

Conversion Factor for Calculating Yield of Butter from the Amount of Butter-fat.—The following resolution was passed by the Association of American Agricultural Colleges and Experiment Stations at the annual convention of the association, July, 1895:

"Resolved, That this association recommends to the several stations that the results of tests of dairy cows or herds be expressed in terms of butter-fat, and that when desirable to express these records in terms of approximate equivalent in butter such equivalent be computed by multiplying the amount of butter-fat by $1\frac{1}{6}$." (Report of Curtiss, Armsby, and Cooke.)

The factor $1\frac{1}{6}$ is based upon the results of the Columbian dairy test, in which it was found that 117.3 lbs. of butter were, on the average, made from each 100 lbs. of butter-fat in the whole milk, and 96.67 lbs. of butter-fat of the milk was recovered in the butter.

YIELD OF BUTTER FROM 100 POUNDS OF CREAM OF DIFFERENT RICHNESS.

(MARTINY.)

Per Ct. Fat in Cream	Yield of Butter.	Per Ct. Fat in Cream.	Yield of Butter.	Per Ct. Fat in Cream.	Yield of Butter.
	lbs.		lbs.		lbs.
15	15.7	22	23.0	29	30.3
16	16.7	23	24.0	30	31.4
17	17.7	24	25.1	31	32.4
18	18.8	25	26.1	32	33.5
19	19.9	26	27.2	33	34.5
20	21.0	27	28.2	34	35.5
21	22.0	28	29.3	35	36.6

YIELD OF BUTTER CORRESPONDING TO YIELD OF BUTTER-FAT PER DAY AND PER WEEK, in Pounds.

Fat.	Butter.	Fat.	Butter.	Fat.	Butter.	Fat.	Butter.
			A. Per Day.				
0.30	0.35	0.95	1.11	1.60	1.87	2.25	2.63
.35	.41	1.00	1.17	1.65	1.93	2.30	2.68
.40	.47	1.05	1.23	1.70	1.98	2.35	2.74
.45	.53	1.10	1.28	1.75	2.04	2.40	2.80
.50	.58	1.15	1.34	1.80	2.10	2.45	2.86
.55	.64	1.20	1.40	1.85	2.16	2.50	2.92
.60	.70	1.25	1.46	1.90	2.22	2.55	2.98
.65	.76	1.30	1.52	1.95	2.28	2.60	3.03
.70	.82	1.35	1.58	2.00	2.33	2.65	3.09
.75	.88	1.40	1.63	2.05	2.39	2.70	3.15
.80	.93	1.45	1.69	2.10	2.45	2.75	3.21
.85	.99	1.50	1.75	2.15	2.51	2.80	3.27
.90	1.05	1.55	1.81	2.20	2.57	2.85	3.33
			B. Per Week.				
5.00	5.83	7.50	8.75	10.00	11.67	12.50	14.58
5.10	5.95	7.60	8.87	10.10	11.78	12.60	14.70
5.20	6.07	7.70	8.98	10.20	11.90	12.70	14.82
5.30	6.18	7.80	9.10	10.30	12.02	12.80	14.93
5.40	6.30	7.90	9.22	10 40	12.13	12.90	15.05
5.50	6.42	8.00	9.33	10.50	12.25	13.00	15.17
5.60	6.53	8.10	9.45	10.60	12.37	13.10	15.28
5.70	6.65	8.20	9.57	10.70	12.48	13.20	15.40
5.80	6.77	8.30	9.68	10.80	12.60	13.30	15.52
5.90	6.88	8.40	9.80	10.90	12.72	13.40	15.63
6.00	7.00	8.50	9.92	11.00	12.83	13.50	15.75
6.10	7.12	8.60	10.03	11.10	12.95	13.60	15.87
6.20	7.23	8.70	10.15	11.20	13.07	13.70	15.98
6.30	7.35	8.80	10.27	11.30	13.18	13.80	16.10
6.40	7.47	8.90	10.38	11.40	13.30	13.90	16.22
6.50	7.58	9.00	10.50	11.50	13.42	14.00	16.33
6.60	7.70	9.10	10.62	11.60	13.53	14.10	16.45
6.70	7.82	9.20	10.73	11.70	13.65	14.20	16.57
6.80	7.93	9.30	10.85	11.80	13.77	14.30	16.68
6.90	8.05	9.40	10.97	11.90	13.88	14.40	16.80
7.00	8.17	9.50	11.08	12.00	14.00	14.50	16.92
7.10	8.28	9.60	11.20	12.10	14.12	14.60	17.03
7.20	8.40	9.70	11.32	12.20	14.23	14.70	17.15
7.30	8.52	9.80	11.43	12.30	14.35	14.80	17.27
7.40	8.63	9.90	11.55	12.40	14.47	14.90	17.38

Fat.	Butter.	Fat.	Butter.
.01	.01	.06	.07
.02	.02	.07	.08
.03	.04	.08	.09
.04	.05	.09	.11
.05	.06	.10	.12

VALUE OF $\frac{100s - 100}{s}$ FOR SP. GR. OF MILK FROM 1.019 TO 1.0399.

(See p. 261.)

Sp.gr. (s) =	0.0000	0.0001	0.0002	0.0003	0.0004	0.0005	0.0006	0.0007	0.0008	0.0009
1.019	1.864	1.874	1.884	1.894	1.903	1.913	1.922	1.932	1.941	1.951
1.020	1.961	1.970	1.980	1.990	1.999	2.009	2.018	2.028	2.038	2.047
1.021	2.057	2.066	2.076	2.086	2.095	2.105	2.114	2.124	2.133	2.143
1.022	2.153	2.162	2.172	2.181	2.191	2.200	2.210	2.220	2.229	2.239
1.023	2.249	2.258	2.267	2.277	2.286	2.296	2.306	2.315	2.325	2.334
1.024	2.344	2.353	2.363	2.372	2.382	2.391	2.401	2.410	2.420	2.430
1.025	2.439	2.449	2.458	2.468	2.477	2.487	2.496	2.506	2.515	2.525
1.026	2.534	2.544	2.553	2.563	2.573	2.582	2.591	2.601	2.610	2.620
1.027	2.629	2.638	2.648	2.657	2.667	2.676	2.686	2.695	2.705	2.714
1.028	2.724	2.733	2.743	2.752	2.762	2.771	2.781	2.790	2.799	2.809
1.029	2.818	2.828	2.837	2.847	2.856	2.865	2.875	2.884	2.893	2.903
1.030	2.912	2.922	2.931	2.941	2.951	2.960	2.969	2.979	2.988	2.997
1.031	3.007	3.016	3.026	3.035	3.044	3.054	3.063	3.072	3.082	3.091
1.032	3.101	3.110	3.120	3.129	3.138	3.148	3.157	3.166	3.176	3.185
1.033	3.195	3.204	3.213	3.223	3.232	3.241	3.251	3.260	3.269	3.279
1.034	3.288	3.298	3.307	3.316	3.326	3.335	3.344	3.354	3.363	3.372
1.035	3.382	3.391	3.400	3.410	3.419	3.428	3.438	3.447	3.456	3.466
1.036	3.475	3.484	3.494	3.503	3.512	3.521	3.531	3.540	3.549	3.559
1.037	3.568	3.577	3.587	3.596	3.605	3.614	3.624	3.633	3.642	3.652
1.038	3.661	3.670	3.679	3.689	3.698	3.707	3.717	3.726	3.735	3.744
1.039	3.754	3.763	3.772	3.781	3.791	3.800	3.809	3.818	3.828	3.837

RELATION OF FAT CONTENT TO ACIDITY OF SKIM-MILK, MILK, AND CREAM. (A. Vind.)

(See p. 306.)

	Skim-milk.		Whole Milk.		Cream.							
Fat contents.....	0 per ct.		5 per ct.		25 per ct.		30 per ct.		35 per ct.		40 per ct.	
	cc.	%	cc.	%	cc.	%	cc.	%	cc.	%	cc.	%
Equal acidity test	10	.18	9.5	.17	7.5	.14	7	.13	6.5	.12	6	.11
" " "	45	.81	43	.77	34	.61	31.5	.57	29	.52	27	.49
" " "	48	.86	45.5	.82	36	.65	33.5	.60	31	.56	29	.52
" " "	50	.90	48	.86	37.5	.67	35	.63	32.5	.58	30	.54
" " "	52	.94	49.5	.89	39	.70	36.5	.66	34	.61	31	.56
" " "	54	.97	51	.92	40.5	.73	38	.68	35	.63	32.5	.58
" " "	55	.99	52	.94	41	.74	38.5	.69	36	.65	33	.59
" " "	57	1.03	54	.97	43	.77	40	.72	37	.67	34	.61
" " "	59	1.06	56	1.01	44	.79	41.5	.75	38.5	.69	35.5	.64
" " "	60	1.08	57	1.03	45	.81	42	.76	39	.70	36	.65

THE SLIDING-SCALE OVERRUN. (Farrington.)

Fat in Milk.	Fat Recovered in Butter.	Butter from 100 lbs. Fat.	Fat in Milk.	Fat Recovered in Butter.	Butter from 100 lbs. Fat.	Fat in Milk.	Fat Recovered in Butter.	Butter from 100 lbs. Fat.
Per Cent.	Per Cent.	Lbs.	Per Cent.	Per Cent.	Lbs.	Per Cent.	Per Cent.	Lbs.
2.5	95.80	115.4	4.1	97.45	117.4	5.6	98.13	118.2
2.6	95.96	115.6	4.2	97.51	117.5	5.7	98.16	118.2
2.7	96.12	115.8	4.3	97.56	117.5	5.8	98.20	118.3
2.8	96.25	116.0	4.4	97.62	117.6	5.9	98.22	118.3
2.9	96.38	116.1	4.5	97.67	117.7	6.0	98.25	118.4
3.0	96.51	116.2	4.6	97.72	117.7	6.1	98.28	118.4
3.1	96.62	116.4	4.7	97.77	117.8	6.2	98.31	118.4
3.2	96.73	116.5	4.8	97.82	117.8	6.3	98.33	118.5
3.3	96.83	116.7	4.9	97.86	117.9	6.4	98.36	118.5
3.4	96.91	116.8	5.0	97.90	117.9	6.5	98.38	118.5
3.5	97.00	116.9	5.1	97.95	118.0	6.6	98.41	118.5
3.6	97.10	117.0	5.2	97.99	118.1	6.7	98.43	118.6
3.7	97.16	117.1	5.3	98.03	118.1	6.8	98.46	118.6
3.8	97.24	117.2	5.4	98.06	118.1	6.9	98.48	118.6
3.9	97.31	117.2	5.5	98.10	118.2	7.0	98.51	118.7
4.0	97.38	117.3						

The table is based on the assumptions that 85 per cent skim-milk and 10 per cent buttermilk are obtained, testing .1 and .2 per cent of fat, respectively; furthermore, that the butter contains 83 per cent fat.

Example.—3450 lbs. of milk testing 4.2 per cent fat contain $3450 \times .042 = 144.9$ lbs. of butter-fat; this multiplied by the overrun for milk testing 4.2 per cent, 1.175 gives 170.25 lbs. as the calculated amount of butter which the milk would make.

COMPARATIVE PRICES OF MILK, CREAM, BUTTER-FAT AND BUTTER. (Doane.)

Cream Per Cent Fat.	Price per Gallon.	3.5% Milk.	4.5% Milk.	5.5% Milk.	Butter Fat per Pound.	Butter per Pound.
		Price per Quart.				
	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.
20	50	12	14.5	17	28	23.5
20	55	12	15.5	18	31	26
20	60	13.5	16.5	19.5	34	28
20	65	14.5	18	21	37	31
20	70	15.5	19	22	40	33
22	50	11	13	15	25	21
22	55	12	14.5	17	28	23.5
22	60	13	15.5	18	31	26
22	65	13.5	16.5	19.5	33.5	28
22	70	14.5	17.5	20.5	36	30
22	75	15	18.5	22	39	32.5
25	55	11	13	15	25	21
25	60	11.5	14	16.5	27	22.5
25	65	12.5	15	17.5	29.5	24.5
25	70	13	16	18.5	32	26.5
25	75	14	17	19.5	34.5	28.5
25	80	14.5	17.5	20.5	36.5	30.5

POUNDS OF MILK REQUIRED TO MAKE ONE POUND OF BUTTER.

Per Cent Fat in Milk.	Lbs. of Milk per 1 lb. of Butter.	Per Cent Fat in Milk.	Lbs. of Milk per 1 lb. of Butter.
2.8	31.1	5.0	17.4
3.0	29.0	5.2	16.7
3.2	27.2	5.4	16.1
3.4	25.5	5.6	15.5
3.6	24.2	5.8	15.0
3.8	22.9	6.0	14.5
4.0	21.7	6.2	14.0
4.2	20.7	6.4	13.6
4.4	19.8	6.6	13.2
4.6	18.9	6.8	12.8
4.8	18.1	7.0	12.4

Lbs. of Milk per 1 lb. of Butter.	Per Cent Fat in Milk.	Lbs. of Milk per 1 lb. of Butter.	Per Cent Fat in Milk
10	8.70	26	3.34
11	7.90	27	3.22
12	7.25	28	3.11
13	6.69	29	3.00
14	6.21	30	2.90
15	5.80	31	2.81
16	5.44	32	2.72
17	5.12	33	2.64
18	4.83	34	2.56
19	4.58	35	2.48
20	4.35	36	2.42
21	4.14	37	2.35
22	3.95	38	2.29
23	3.78	39	2.23
24	3.62	40	2.17
25	3.47		

The two preceding tables are based on ordinary creamery experience, 1 pound of fat in the milk producing 1.15 pounds of butter.

NUMBER OF POUNDS OF MILK REQUIRED FOR MAKING ONE POUND OF BUTTER. (Kirchner.)

Lbs. Butter per 100 lbs. of Milk.	Lbs. Milk per 1 lb. of Butter.	Lbs. Butter per 100 lbs. of Milk.	Lbs. Milk per 1 lb. of Butter.
2.4	41.67	3.8	26.32
2.5	40.00	3.9	25.64
2.6	38.46	4.0	25.00
2.7	37.04	4.1	24.39
2.8	35 71	4.2	23.81
2.9	34.48	4.3	23.26
3.0	33.33	4.4	22.73
3.1	32.26	4.5	22.22
3.2	31.25	4.6	21.74
3.3	30.30	4.7	21.28
3.4	29.41	4.8	20.83
3.5	28.57	4.9	20.41
3.6	27.68	5.0	20.00
3.7	27.03	5.5	18.18

DISTRIBUTION OF MILK INGREDIENTS IN BUTTER MAKING. (Cooke.)

	Total Solids.	Fat.	Casein.	Albumen.	Milk Sugar.	Ash.	Proportion of the Total Milk Fat found in the Product.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
1000 lbs. of whole milk....	130.0	40.0	26.0	7 0	49.5	7.5	..
800 lbs. of skim-milk. ...	78.0	2.4	22.0	6.0	41.2	6.4	6
200 lbs. of cream..	52.0	37.6	4.0	1.0	8.3	1.1	94
187 lbs. of buttermilk.....	14.91	.8	3.77	.94	8.3	1.1	2
43.3 lbs. of butter........	37.09	36.8	.23	.06	..	..	92

SCORE FOR JUDGING BUTTER GENERALLY ADOPTED IN AMERICAN CONTESTS.

Flavor...........................	45
Grain (body).....................	25
Color...........................	15
Salt.............................	10
Packing (style)..................	5
	100

This score has been adopted in judging butter exhibits at various State fairs and dairymen's conventions during late years; in some cases the score has been changed to 50 for flavor and 5 for salting, otherwise as above, or to flavor 40, grain 30, with other points as above.

Minimum number of points entitling exhibitors to a premium:

Wisconsin Dairymen's Association, 93, 95, and 94 points, for dairy, separator creamery, and gathered-cream butter, respectively.

New York State Fair, 75 points.

ENGLISH SCALE OF POINTS FOR JUDGING BUTTER. (McConnell.)

Perfection, 100.

25 Flavor: nutty, aromatic, sweet.
20 Moisture: as free from beads of water as possible.
10 Solidity: firm, not melting easily, nor softening.
25 Texture: closeness of grain, distinct fracture; not greasy.
10 Color: natural, even.
10 Make: remaining points, cleanliness, salting, nicely put up, etc.
—
100

SCORE IN JUDGING PROFICIENCY OF BUTTER-MAKERS.

(Adopted by British Dairy Farmers' Association.)

Butter-making.

Preparation of cream	4	Salting	5
" " utensils	6	Making up	15
Ventilation of churn	4	Flavor and color	7
Judgment and skill in churning	15	Texture and freedom from moisture	7
Washing butter in churn	10	Cleaning utensils	4
Use of strainer	4	Rapidity and cleanliness of working	5
" " thermometer	7		
" " butter-worker	7		100

ANALYSES OF AMERICAN DAIRY SALTS.

(In Per Cent.*)

Name of Brand.	Sodium Chlorid.	Calcium Sulfate.	Calcium Chlorid.	Magnesium Chlorid.	Insoluble Matter.	Moisture.	Apparent Specific Gravity.	Comparative Rate of Solubility, Sec.
Acme	98.39	1.22	.12	.07	.03	.17	.944	24
Anchor	97.79	1.48	.28	.08	.06	.31	1.125	31
Ashton	98.01	1.42	.20	.16	.03	.18	.703	39
Bradley	98.27	.90	.40	.07	.02	.34	.876	63
Canfield & Wheeler	98.18	1.21	.22	.12	.04	.23	1.062	26
Diamond Crystal	99.18	.54	.19	.05	.03	.01	.880	33
Empire	98.58	.66	.54	.10	.02	.10	.933	32
Genesee	98.27	1.11	.24	.07	.04	.16	.875†	31†
Higgins	98.19	1.44	.14	.10	.02	.11	.907	28
Le Roy	98.15	1.31	.39	.08	.01	.06	1.094‡	25‡
Lone Star	98.24	1.46	.06	.08	.06	.10	1.072	28
Vacuum Pan	98.00	1.15	.36	.15	.03	.31	1.075	30
Warsaw	98.43	.95	.40	.06	.03	.12	.962	39
Worcester	98.57	.92	.25	.07	.02	.17	1.149	29
Colcman	98.21	1.48	.10	.04	.08	.09	.865	28
Rice	97.57	1.85	.12	.09	.07	.30	.828	30
Windsor	98.43	.90	.51	.04	.02	.11	1.107§	26§

* See *Woll*, "A Study of Dairy Salt," Bulletin No. 74, Wis. Exp. Sta.
† Butter-salt; cheese-salt, appar. sp. gr. .671; rate of solubility 34 sec.
‡ Butter-salt; cheese-salt, appar. sp. gr. .944; rate of solubility 37 sec.
§ Butter-salt; cheese-salt, appar. sp. gr. .891; rate of solubility 32 sec.

TEMPERATURES AT WHICH DAIRY PRODUCTS SHOULD BE STORED IN COLD STORAGE. (DOUGLAS.)

Article.	Temperature, deg. F.	Article.	Temperature, deg. F.
Butter	25–38	Milk	32
Butter, to freeze	20	Oleomargarine	20–35
Butterine	20–35	Poultry, frozen	28–30
Cheese	28–35	Poultry, to freeze	10–18
Cream	35	Poultry, long storage	10
Eggs	28–35		

V. CHEESE.

HOW AMERICAN CHEESE IS MADE.

By the late Prof. John W. Decker, of Ohio Dairy School, Author of "Cheese Making: Cheddar, Swiss, Brick, etc."

A. Factory or Cheddar Cheese.

As soon as the milk is received at the factory it is heated to 86° F. and a rennet test made.*

If the milk is not ripe enough it is held till the proper acidity is reached. If the milk is very sweet a starter of sour milk is added to hasten it. The milk should be set at such a ripeness that there will be one eighth of an inch of acid (fine strings) on the hot-iron in two hours and a half from the time rennet is added.

If the cheese is to be colored the color is added just before setting the milk. When it is thoroughly stirred in, the rennet may be added. The amount of rennet to be used depends on the kind of cheese desired. If a soft fast-curing cheese is wanted, enough rennet is used to coagulate the milk in fifteen to twenty minutes; if a slow-curing cheese, enough to coagulate in thirty to forty-five minutes. It is stirred in thoroughly in four or five minutes and then the dipper is run lightly over the top, to keep the cream down till the milk begins to thicken, when a cloth cover is spread over the vat and the coagulation allowed to continue till the curd will break clean over the fingers.

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* The *Monrad* rennet test is recommended. It consists of a 160 cc. tin cylinder for measuring the milk, a 5 cc. pipette, a 50 cc. graduated flask, and a half-pint tin basin. The rennet is measured with the 5 cc. pipette and delivered into the 50 cc. flask, the rennet adhering to the pipette being rinsed into the flask with a little water. The flask is then filled with water to the 50 cc. mark, and the solution mixed by shaking. The milk, the temperature of which should be 86° F., is measured in the tin cylinder, emptied into the half-pint basin, and 5 cc. of the dilute extract is measured into the 160 cc. of milk, and the number of seconds required to curdle it noted. If a few specks of charcoal are scattered on the milk and the milk started into motion around the dish with a thermometer, the instant of curdling can be noted by the stopping of the specks. They will stop so suddenly as to seem to start back in the opposite direction. The *Marschall* rennet test is a very convenient device for ascertaining the exact moment of coagulation, and is used extensively in cheese factories.

The curd is then cut, using the horizontal knife first and cutting lengthwise of the vat. The cutting is finished from this point with the perpendicular knife, the curd being thus cut into cubes one-half inch in diameter. Without waiting for the curd to settle, begin stirring very carefully with a wire basket, and rub the curd off from the sides of the vat with the hand. As soon as this is done, turn on the heat carefully and raise the temperature slowly to 98° F.; when the curd is firm enough a wooden rake is used to stir it. The temperature is raised at the rate of one deg. in 4–5 min.

As soon as the temperature of 98° F. is reached, begin trying the curd on the hot iron for acid. The curd must be firm enough when the whey is drawn, so that a double handful pressed together will fall apart readily. This is the test for a proper cooking. When fine threads ⅛ in. long show on the hot iron the whey is ready to draw.* This should be 2½ hrs. from the time the milk was set. The whey is drawn off by means of a whey gate and strainer, and the curd dipped into a curd-sink or on racks placed in the vat, over which a linen strainer-cloth is thrown. The curd should be stirred on the cloth to facilitate the escape of the whey, and is then left to mat together. In 15 or 20 min. it can be cut into blocks 8 or 10 ins. square, and turned over. After turning several times these blocks can be piled two or three deep. The acid will continue to develop in the curd; when it will string about an inch it will have assumed a stringy or meaty texture, so that it will tear like the meat on a chicken's breast.

It is then run through the curd-mill and cut up into small pieces. These pieces are stirred up every little while to air. In the course of another hour and a half there will be 2 in. of acid on the curd; it will smell like toasted cheese when pressed against the hot iron, and half fat and half whey will run out

* The *acidimeter* is sometimes used to take the place of the rennet test and hot iron. The apparatus is sold by firms handling dairy supplies. The milk is set at an acidity of .2 per cent. When cut the whey will have a lower acidity, probably .17 per cent. When the acidity in the whey reaches .2 per cent the whey is drawn. The drawings from the curd will show a rapid increase in acid. This test should be used with care and in combination with rennet test and hot iron.

when a handful is squeezed. It is then ready to salt. It is cooled to 80° F. before salting. If a fast-curing cheese is wanted use 2 lbs. per 100 lbs. of curd; 2½ lbs. are used for a medium cheese, 3 lbs. for a slow-curing cheese. The curd should be spread out at an even thickness and the salt applied evenly. It should then be thoroughly stirred several times.

As soon as the harsh feeling has left the curd it is ready to go to press. The screw should be turned slowly, but fast enough so that a stream of brine is kept flowing. The full pressure should not be applied for ten minutes. In an hour the bandages can be turned down, and full pressure is then applied. The Helmer continuous-pressure gang-press is the most satisfactory, as the cheese will not loosen during the night. The next day the cheese are placed on the shelves and the rinds greased. They should be turned and rubbed every day. The temperature of the curing-room should be 60° to 65° F., and moisture should be supplied in dry weather. The cheese are boxed and shipped in about a month.

B. Cheese Made on the Farm.

For a farm dairy it will be much easier to make up sweet-curd cheese than sour-curd cheese, described in the preceding. For this purpose it is necessary to have a curd-knife, a cheese-vat, and a cheese-press; the method of procedure is as follows:

The milk, which must be clean and sweet, is heated to 90° F., and if any artificial color is required it is added at this time. Set the milk with enough rennet extract to coagulate in 20 to 30 minutes. About four ounces of Hansen's rennet extract per 1000 lbs. of milk will prove a sufficient amount.

As soon as the curd will break over the finger cut it fairly fine; then raise the temperature one degree in 3 minutes until 108° F. is reached, at the same time stirring carefully to keep the curd particles apart. Hold at 108° F. till the curd is firm, that is, till the pieces do not feel mushy. Then draw the whey and stir till the whey is well drained out. Salt at the rate of 2½ lbs. of salt to 100 lbs. of curd, and when the salt is well worked in it may be put to press. It will, however, improve the quality if kept warm and allowed to stand a number of hours before salting and pressing. The cheese should be cured in a room (preferably

a cellar) where the temperature can be kept at 60° F. Higher temperatures may spoil it. The cheese should be cured for two to three months before it is sold.

CAUSES OF TAINTED MILK.

The causes of tainted milk have been classified as follows, by the Swiss scientist, Dr. Gerber:

1. Poor, decayed fodders, or irrational methods of feeding.
2. Poor, dirty water, used for drinking-water or for the washing of utensils.
3. Foul air in cow-stable, or the cows lying in their own dung.
4. Lack of cleanliness in milking; manure particles on udder.
5. Keeping the milk long in too warm, poorly ventilated and dirty places.
6. Neglecting to cool the milk rapidly, directly after milking.
7. Lack of cleanliness in the care of the milk, from which cause the greater number of milk taints arise.
8. Poor transportation facilities.
9. Sick cows, udder diseases, etc.
10. Cows being in heat.
11. Mixing fresh and old milk in the same can.
12. Rusty tin pails and tin cans (Böggild).

DETECTING BAD MILK: DIRECTIONS FOR OPERATING THE WISCONSIN CURD-TEST.

Cheese-makers are often troubled with so-called *floating*, *pinholed*, or *gassy* curds which produce cheese defective in flavor and texture. The cause of this poor quality of cheese often seems beyond the power of the operator to determine. While he has heretofore usually laid it to "bad" milk, it was often impossible for him to locate the trouble. By means of the curd-test the operator is usually able to tell which patron or patrons are furnishing the bad milk; and often in the patron's herd it will be shown to be due to a single cow. This test as here described originated at the

Wisconsin Dairy School in 1895. Apparatus for making the test is now furnished by dairy supply-houses, although a home-made test can be improvised by using pint fruit-jars and a wash-tub or some small tank, in which the jars of milk can be heated in warm water.

DETAILS OF THE TEST.—1. A pint glass jar which has been thoroughly cleaned, and sterilized with live steam, is filled about two thirds full with the milk to be tested.

2. It is not necessary to take an exact quantity of milk, but each jar should be plainly labeled.

3. The numbered jars of milk are placed in a tank or tub of water which is heated until the milk in the jars has a temperature of 98° F.

4. The thermometer used should first be rinsed in boiling water before being placed in another sample, to avoid contamination of good milk with bad milk.

5. When the milk has reached a temperature of 98° F., add 10 drops of rennet extract to each jar of milk, and mix by giving the jar a rotary motion.

6. The rennet soon curdles the milk, and the curd is allowed to stand for about twenty minutes until it is firm.

7. The curd should then be cut into small pieces with a case-knife, and after settling the whey is poured off. The best tests are made when the separation of whey is most complete. By allowing the samples to stand for a short time, more whey can be poured off, and the curd thereby rendered firmer.

8. The jars containing the curd are then again placed in the tub and the temperature of the water around the jars is maintained at or near 98° F. by adding hot water from time to time. The tub or vat is covered, the curds are allowed to ferment in the sample jars for six to twelve hours and are then examined.

9. The impurities in any particular sample will cause gases to be developed in the curd, so that when it is cut with a knife pin-holes or gas-holes can be easily detected. Milks having a putrefactive or stinking odor should be classed as bad, even though the curd has a good texture and is free from pin-holes.

The curds in this test are made under conditions most favorable for developing in them any defects which may be caused by the presence of undesirable bacteria that are brought to the milk by dust, dirt, and other impurities.

The odor of a curd should be noticed as soon as the cover is taken from a jar. This is often sufficient to convince a patron that the milk is tainted, and may suggest to him the particular cause of the odor by its resemblance to some familiar smell that he recognizes and can remove.

A solid firm curd shows that the milk is pure and clean and has been properly handled. The rather firm curds which show fine *pin-holes* when cut with a knife are indications of some of the worst impurities in milk, while the spongy curds show the presence of bacteria which in some cases have developed sufficient gas to float the curd. Persons familiar with milk soon learn to use the evidence obtained by this test to distinguish between good and bad milk, and to convince the milk-producers of the value of the test. (Dairy Bull., Wis. Exp. Station.)

THE FERMENTATION TEST.

The *Gerber* fermentation test (modified by *Monrad*) furnishes a convenient method for discovering tainted milk on the farm or at the factory. The test consists of a tin tank which can be heated by means of a small lamp, and into which a rack fits holding a certain number of cylindrical glass tubes; these are all numbered and provided with a mark and a tin cover. In making the test the tubes are filled to the mark with milk, the number of each tube being recorded in a notebook opposite the name of the particular patron whose milk was placed therein. The tubes in the rack are put in the tank, which is two thirds full of water; the temperature of the water is kept at 104–106° F. for six hours, when the rack is taken out, the tubes gently shaken, and the appearance of the milk, its odor, taste, etc., carefully noted in each case. The tubes are then again heated in the tank at the same temperature as before for another six hours, when observations are once more taken of the ap-

pearance of the milk in each tube. The tainted milk may then easily be discovered on account of the abnormal coagulation of the sample.

Gerber concluded from over 1500 tests made by this method:

1. That good and properly handled milk should not coagulate in less than 12 hours, nor show anything abnormal when coagulated.

2. If it does, it shows the milk to be abnormal, either on account of its chemical composition or because it is impregnated with too much ferment (rather, abnormal ferments, causing an undesirable fermentation).

3. Milk from sick cows, cows that are strongly in heat, or cows with diseased udders will always coagulate in less than 12 hours.

4. Only about 20 per cent of the tests coagulated within 12 hours.

Monrad proposes the following rules for the adoption of this test by cheese factories:

1. "A proper journal is kept of all the tests.

2. "The patrons whose milk is tainted have to pay the cost of making the test.

3. "The patrons whose milk is tainted will be kept track of, and in case there is any loss caused thereby they will have to stand it.

4. "Patrons having tainted milk shall be notified at once, and another test made three days later. If then the milk is still bad, a test of each cow's milk is made on the farm and otherwise the reason sought to be discovered, and until then the milk will be refused."

DETERMINATION OF HUMIDITY IN CHEESE-CURING ROOMS.

The proper degree of humidity in the cheese-curing room will vary with different kinds of cheese and at different stages of the curing process. Green cheese should be placed in a somewhat drier curing-room than older; the latter kinds, according to Fleischmann, require a relative humidity of 90°–95°, against 85°–90° for green cheese.

Kirchner states that the humidity of curing-rooms should not, in general, go below 80° or above 95°. Temperatures from 50°–70° F. are preferable in the curing-room.

The following temperatures and percentages of humidity are recommended by Martiny:

	Deg. Fahr.	Per Cent Humidity
(*a*) *For hard cheeses* (Swiss, etc.).		
Green	59–63	90–95
Half cured	54–59	85–90
Cured	50–54	80–95
(*b*) *For soft cheeses* (Limburger, etc.)	50–59	80–95

In the interior of our continent it is somewhat difficult to obtain as much moisture in the air of curing-rooms as is represented by the preceding figures; the relative humidity of ordinary curing-rooms in this region, therefore, but rarely goes over 60°. A higher degree of humidity may be obtained by hanging wet sheets of canvas in the curing-room (Decker), or by similar devices, as described in the thirteenth ann. report of Wis. Experiment Station.

Self-recording thermometers are to be recommended for use in curing-rooms. For observation of relative humidity a wet and dry bulb thermometer, a Mittchoff's hygrometer, or a Lambrecht's polymeter may be used to advantage. Any of these instruments may be obtained through dealers in chemical glassware or dairy supplies; the prices range from $8 to $30.

TABLE SHOWING THE RELATIVE HUMIDITY IN THE AIR OF CURING-ROOMS. (King.)

Directions.—Notice that the table is in three column sections. Find air temperature in first column, then find wet-bulb temperature in second column, same division. In third column opposite this is relative humidity.

Example.—Air temperature is 50°, in first column; wet-bulb is 44°, in second column, same division. Opposite 44° is 61, which is the per cent of saturation, or the relative humidity of the air.

Caution.—Fan the bulb briskly for a minute or two before taking reading.

Dry Bulb.	Wet Bulb.	Rel. Hum.
40	32	37
	33	44
	34	52
	35	59
	36	68
	37	76
	38	84
	39	92
41	32	31
	33	38
	34	46
	35	53
	36	60
	37	68
	38	76
	39	84
	40	92
42	33	33
	34	40
	35	47
	36	54
	37	61
	38	69
	39	77
	40	84
	41	92
43	33	28
	34	34
	35	41
	36	48
	37	55
	38	62
	39	70
	40	77
	41	85
	42	92
44	34	29
	35	36
	36	43
	37	49
	38	56
	39	63
	40	70
	41	78
	42	85
	43	92

Dry Bulb.	Wet Bulb.	Rel. Hum.
45	35	31
	36	37
	37	44
	38	50
	39	57
	40	64
	41	71
	42	78
	43	85
	44	92
46	35	26
	36	32
	37	38
	38	45
	39	51
	40	58
	41	65
	42	72
	43	79
	44	85
	45	93
47	36	28
	37	34
	38	40
	39	46
	40	52
	41	59
	42	66
	43	72
	44	79
	45	86
	46	93
48	37	29
	38	35
	39	41
	40	47
	41	53
	42	60
	43	66
	44	73
	45	79
	46	86
	47	93
49	38	30
	39	36
	40	42

Dry Bulb.	Wet Bulb.	Rel. Hum.
49	41	48
	42	54
	43	60
	44	67
	45	73
	46	80
	47	86
	48	93
50	39	32
	40	37
	41	43
	42	49
	43	55
	44	61
	45	67
	46	74
	47	80
	48	87
	49	93
51	40	33
	41	39
	42	45
	43	50
	44	56
	45	62
	46	68
	47	74
	48	81
	49	87
	50	93
52	41	35
	42	40
	43	46
	44	51
	45	57
	46	63
	47	69
	48	75
	49	81
	50	87
	51	94
53	41	31
	42	36
	43	41
	44	47
	45	52

Dry Bulb.	Wet Bulb.	Rel. Hum.
53	46	58
	47	63
	48	69
	49	75
	50	81
	51	87
	52	94
54	42	32
	43	37
	44	42
	45	48
	46	53
	47	59
	48	64
	49	70
	50	76
	51	82
	52	88
	53	94
55	43	33
	44	38
	45	43
	46	49
	47	54
	48	59
	49	65
	50	70
	51	76
	52	82
	53	88
	54	94
56	44	34
	45	39
	46	44
	47	50
	48	55
	49	60
	50	65
	51	71
	52	77
	53	82
	54	88
	55	94
57	45	36
	46	40
	47	45

HUMIDITY IN THE AIR OF CURING-ROOMS.—*Con.*

Dry Bulb.	Wet Bulb.	Rel. Hum.
57	48	50
	49	55
	50	61
	51	66
	52	71
	53	77
	54	83
	55	88
	56	94
58	46	37
	47	42
	48	46
	49	51
	50	56
	51	61
	52	67
	53	72
	54	78
	55	83
	56	89
	57	94
59	47	38
	48	43
	49	47
	50	52
	51	57
	52	62
	53	67
	54	72
	55	78
	56	83
	57	89
	58	94
60	48	39
	49	44
	50	48
	51	53
	52	58
	53	63
	54	68
	55	73
	56	78
	57	84
	58	89
	59	94
61	49	40
	50	44
	51	49
	52	54
	53	58
	54	63
	55	68
	56	73
	57	78
61	58	84
	59	89
	60	94
62	50	41
	51	45
	52	50
	53	54
	54	59
	55	64
	56	69
	57	74
	58	79
	59	84
	60	89
	61	95
63	51	42
	52	46
	53	51
	54	55
	55	60
	56	64
	57	69
	58	74
	59	79
	60	84
	61	89
	62	95
64	52	43
	53	47
	54	51
	55	56
	56	60
	57	65
	58	70
	59	74
	60	79
	61	85
	62	90
	63	95
65	53	44
	54	48
	55	52
	56	56
	57	61
	58	65
	59	70
	60	75
	61	80
	62	85
	63	90
	64	95
66	53	40
	54	45
66	55	49
	56	53
	57	57
	58	61
	59	66
	60	71
	61	75
	62	80
	63	85
	64	90
	65	95
67	54	41
	55	45
	56	49
	57	53
	58	58
	59	62
	60	66
	61	71
	62	76
	63	80
	64	85
	65	90
	66	95
68	55	42
	56	46
	57	50
	58	54
	59	58
	60	63
	61	67
	62	71
	63	76
	64	81
	65	85
	66	90
	67	95
69	56	43
	57	47
	58	51
	59	55
	60	59
	61	63
	62	67
	63	72
	64	76
	65	81
	66	86
	67	90
	68	95
70	57	44
	58	48
	59	52
	60	55
70	61	60
	62	64
	63	68
	64	72
	65	77
	66	81
	67	86
	68	90
	69	95
71	58	45
	59	48
	60	52
	61	56
	62	60
	63	64
	64	68
	65	72
	66	77
	67	81
	68	86
	69	91
	70	95
72	59	45
	60	49
	61	53
	62	57
	63	61
	64	65
	65	69
	66	73
	67	77
	68	82
	69	86
	70	91
	71	95
73	60	46
	61	50
	62	53
	63	57
	64	61
	65	65
	66	69
	67	73
	68	78
	69	82
	70	86
	71	91
	72	95
74	61	47
	62	50
	63	54
	64	58
	65	62
	66	66

HUMIDITY IN THE AIR OF CURING-ROOMS.—*Con.*

Dry Bulb.	Wet Bulb.	Rel. Hum.	Dry Bulb.	Wet Bulb.	Rel. Hum.	Dry Bulb.	Wet Bulb.	Rel. Hum.	Dry Bulb.	Wet Bulb.	Rel. Hum.
74	67	70	76	63	48	77	72	78	79	69	60
	68	74		64	52		73	83		70	64
	69	78		65	55		74	87		71	68
	70	82		66	59		75	91		72	71
	71	86		67	63		76	95		73	75
	72	91		68	66	78	65	49		74	79
	73	95		69	70		66	53		75	83
75	62	47		70	74		67	56		76	87
	63	51		71	78		68	60		77	91
	64	55		72	82		69	63	80	66	47
	65	58		73	87		70	67		67	51
	66	62		74	91		71	71		68	54
	67	66		75	95		72	75		69	57
	68	70	77	64	49		73	79		70	61
	69	74		65	52		74	83		71	64
	70	78		66	56		75	87		72	68
	71	82		67	59		76	91		73	72
	72	87		68	63	79	66	50		74	75
	73	91		69	67		67	53		75	79
	74	95		70	71		68	57		76	83
				71	74					77	87
										78	92

SCORE FOR JUDGING CHEESE.

	World's Fair 1893.	New York, 1894. For Export.	New York, 1894. For Home Trade.	Wisconsin Dairymen's Assoc. 1894.
Flavor	45	45	50	45
Texture (and body)	20	30	25	30
Color	15	15	15	15
Salting	10	..	..	..
Make up (finish)	10	10	10	10
	100	100	100	100

PERCENTAGE COMPOSITION OF CHEESE. (König.)

	No. of Analyses.	Water.	Fat.	Casein and Albumen.	Nitrogen-free Extract.	Ash.
Cream cheese	27	36.33	40.71	18.84	1.02	3.10
Full cream cheese	143	38.00	30.25	25.35	1.43	4.97
Half-skim cheese	21	39.79	23.92	29.67	1.79	4.73
Skim cheese	41	46.00	11.65	34.06	3.42	4.87
Sour-milk cheese	15	52.36	16.03	36.64	.90	4.07
Whey cheese	7	23.66	16.91	8.90	45.75	4.78

VARIETIES AND ANALYSES OF CHEESE.

(McCONNELL.)

	Water.	Casein.	Fat.	Sugar.	Ash.
	Per ct.	Per ct.	Per ct.	Per ct.	Per ct
British, pressed—					
Cheddar, 3 months........	36.17	24.93	31.83	3.21	3.86
" 6 "	31.17	26.31	33.68	4.91	3.93
" average..	34.38	26.38	32.71	... ...	3.58
Cheshire, new.....	36.96	24.08	29.34	5.17	4.45
" old.	32.59	32.51	26.06	4.53	4.31
Derby	31.68	24.50	35.20	4.38	4.24
Dunlop	38.46	25.87	31.86	....	3.81
Gloucester (single)...... ...	32.50	28.51	28.23	....	4.66
" (double)........	35.96	21.74	26.83	....	4.07
British, soft—					
Cream	30.65	4.94	62.99	....	1.15
Stilton	30.35	28.85	35.39	....	3.82
French, soft—					
Brie..	50.35	17.18	25.12	....	5.41
Camembert....	50.16	21.85	21.13	....	3.89
Gervais (cream)...........	52.94	11.80	20.75	2.58	2.93
Neufchatel...	44.47	14.60	33.70	....	2.99
French, pressed—					
Gruyere...................	34.87	25.87	28.91	... .	3.84
Roquefort...	31.20	27.63	33.16	....	6.01
Dutch—					
Edam (round).............	36.28	24.06	30.26	....	4.90
Gouda (flat)..............	21.90	46.95	24.81	....	6.32
German—					
Backstein............... ..	73.10	19.80	2.80	2.20	2.10
Swiss—					
Backstein....	35.80	24.44	37.40	....	2.36
Bellelay (soft).............	37.59	28.88	30.05	....	3.48
Emmenthaler..............	35.14	30.86	31.00	....	4.00
Italian—					
Gorgonzola................	44.04	28.06	29.84	....	3.87
Parmesan.................	31.34	41.99	19.22	....	6.25
Various—					
American factory..........	25.93	38.12	31.55	....	4.38
Foreign skim, average.....	46.08	33.37	10.54	6.12	3.81
German sour milk..........	63.63	25.27	4.85	....	3.67
Whey cheese (cow)........	24.21	9.06	20.80	41.01	4.02
" " (goat)........	25.29	9.10	20.98	29.21	3.88
Centrifugal skim-milk cheese	50.5	43.1	1.2	....	5.2

DISTRIBUTION OF INGREDIENTS IN CHEESE-MAKING. (COOKE.)

	Total Solids.	Fat.	Casein and Albumen.	Milk-sugar.	Ash.
	Per cent	Per cent	Per cent	Per cent	Per cent
Cheese........	54.2	90.6	77.4	5.0	36
Cheese-press drips...	.9	.4	.6	1.5	1
Whey...............	44.9	9.0	22.0	93.5	63
	100.0	100.0	100.0	100.0	100

DISTRIBUTION OF FERTILIZING INGREDIENTS IN CHEESE-MAKING. (Cooke.)

	Nitrogen.	Phosphoric Acid	Potash.
	lbs.	lbs.	lbs.
1000 lbs. of whole milk........	5.30	1.90	1.75
900 lbs. of whey................	1.35	1.23	1.63
100 lbs. of cheese....	3.95	.65	.12

YIELD OF CHEESE FROM MILK OF DIFFERENT FAT CONTENTS.

Per cent Fat in Milk.	Yield of Cheese from 100 Lbs. of Milk.	Milk per Pound of Cheese.	Per cent Fat in Milk.	Yield of Cheese from 100 Lbs of Milk.	Milk per Pound of Cheese.
	Lbs.	Lbs.		Lbs.	Lbs.
0	5 5	18.2	3	9.15	11.1
1	6.55	15.3	4	10.8	9 3
2	8.0	12.5	5	12.4	8.1

The quality of the cheese and its food value improve with the increase of fat in the milk from which it is made. (Decker.)

FORMULAS FOR FINDING YIELD OF CHEDDAR CHEESE.

The approximate yield of green cheddar cheese from 100 lbs. of milk may be found by multiplying the per cent of fat in the milk by 2.7; if f designate the per cent of fat in the milk, the formula will therefore be:

$$\text{Yield of cheese} = 2.7f.$$

The factor 2.7 will only hold good as the average of a large number of cases. In extensive investigations during three consecutive years Van Slyke found that the number of pounds of green cheese manufactured for one pound of fat in the milk varied from 2.51 to 3.06, the average figures being 2.73, 2.71, and 2.72, for 1892–94, respectively. For cured cheese the factor will be somewhat lower, viz., about 2.6 on the average.

If the percentage of solids not fat and of fat in the sample of milk are known, the following formula, published by Dr. Babcock in the twelfth report of the Wisconsin Ex-

periment Station, will give close results (s = solids not fat; f = fat):

$$\text{Yield of green cheese} = 1.58(\tfrac{1}{2}s + .91f).$$

This formula is based on a water content of 37 per cent in the cheese; it may be readily changed to suit any particular per cent. The average percentages of water in green cheese in Van Slyke's investigations referred to above were 36.41, 37.05, and 36.70 per cent for the years 1892–94, respectively.

If the percentages of casein and fat in the milk are both known, the yield of cheese may be calculated from the following formula, which will give fairly correct results:

$$\text{Yield of cheese} = 1.1f + 2.5 \text{ casein.} \qquad \text{(Babcock.)}$$

YIELD OF DIFFERENT KINDS OF CHEESE FROM 100 LBS. OF MILK. (Fleischmann.)

	Green Cheese.	Cured Cheese.
	lbs.	lbs.
Soft full-cream cheese intended for immediate consumption	25–33	....
Very soft full-cream cheeses (Brie, Camembert, Neufchatel, etc.)	18–22	12–15
Somewhat firmer, full-cream soft cheeses (Limburger, Remondon cheese, etc.)	13–16	9–11
Soft half-skim cheese (Limburg), 1¼ lbs. butter and	12–13	9–11
Soft skim cheeses (*à la* Brie, Camembert, Livarot. Backstein, etc.), 3–3.4 lbs. butter and	7.5–12	6.5–9
Roquefort cheese (made from sheeps' milk)	18	12–14.5
Full-milk, from American and English cheeses, and .75 lbs. whey-butter.	9–11	8–9
Full-milk from Dutch and Swiss cheeses and .75 lbs. whey-butter.	8–11	7–10
Half-skim firm cheeses, 1.6 lbs. butter and	7–10	5–8
Skim-milk cheese, 3–3.5 lbs. butter and	5–7	4–6
Sour-milk cheese, 3–3.5 lbs. butter and	7.5–9	5–6
Scandinavian "Gammelost" and 3–3.5 lbs. butter.	3.5–5.5	2–3
Whey cheese ("Mysost") and butter and skim-milk cheese.	6–7	....

Whey in manufacture of full-cream cheese, 73-88 lbs., average 81 lbs.
" " " " half-skim " 72–80 " " 76 "
" " " " skim cheese 66–76 " " 71 "

Under similar conditions 5-7 lbs. less of whey are obtained in the manufacture of soft cheese than in that of firm cheese.

The *loss* sustained in the manufacture of cheese amounts on the average to 3 lbs. per 100 lbs. of milk, not considering the losses incurred in the curing of the cheese.

AVERAGE LOSS OF AMERICAN CHEDDAR CHEESE IN CURING. (Babcock.)

No. of Group.	Period Covered.	Average Age.	No. of Cheese.	Total Weight Green.	Total Weight Cured.	Loss.	
	Days.	Days.		Lbs.	Lbs.	Lbs.	Per Cent.
1	1–10	6	9	2,812	2,741.5	70.5	2.51
2	11–20	16	242	7,356.9	7,077.0	279.9	3.0
3	21–30	25	298	8,530.5	8,160.4	370.1	4.34
4	31–60	41	417	12,353.3	11,684.4	668.9	5.41
5	Over 60	141	172	6,244.4	5,736.0	508.4	8.11

Total number of cheese in preceding trials .... .1225.
Average weight of green cheese .. . .30.2 lbs.
" temperature of curing-room.....61° F. (range 55–70°).
" humidity of air in curing-room ...... 50 per cent.

LOSS IN WEIGHT OF DIFFERENT KINDS OF CHEESE DURING CURING. (Martiny.)

		Per Cent.
Swiss (Emmenthal)—		
made from whole milk will lose in........5	months.	8–14
" " half-skimmed milk will lose in 8	"	15–20
" " skim-milk will lose in........6	"	12–15
Tilsit—		
made from whole milk will lose in........4	"	12–25
Dutch (Gouda)—		
made from whole milk will lose in........3	"	20–28
" " skim " " " "........4	"	15–25
American Cheddar—		
made from whole milk will lose in........2	"	5
" " " " " " "........4	"	6–7
Limburger or Remoudon—		
made from whole milk will lose in........$2\frac{1}{2}$	"	16–28
Brick cheese—		
made from skim-milk will lose in........$2\frac{1}{2}$	"	15–30
Camembert, Brie, Neufchatel, etc.—		
made from whole milk will lose in........2	"	20–35
Sour-milk cheese—		
made from whole milk will lose in.......$3\frac{1}{2}$	"	50–60

YIELD OF CHEESE FROM 100 LBS. OF MILK and Relative Cheese Value of Milks Corresponding to Per Cent of Fat and Readings of Quevenne Lactometer at 60° F.

(BABCOCK.)

Yield of cheese $= 1.58\left(\frac{T-F}{3} + 91F\right)$.
(In large type—1, 2, 3, etc.)

Relative cheese value of milks $= \frac{1}{5}\left(\frac{T-F}{3} + 6F\right)$.
(In small type—1, 2, 3, etc.)

Per Cent of Fat.	Lactometer Degrees. 26	27	28	29	30	31	32	33	34	35	36	Per Cent of Fat.
3.0	8.05 4.07	8.18 4.09	8.31 4.10	8.45 4.12	8.58 4.14	8.71 4.15	8.84 4.17	8.97 4.19	9.11 4.21	9.24 4.22	9.37 4.24	3.0
3.1	8.21 4.19	8.34 4.21	8.47 4.22	8.60 4.24	8.74 4.26	8.87 4.27	9.00 4.29	9.13 4.31	9.26 4.33	9.39 4.34	9.53 4.36	3.1
3.2	8.36 4.31	8.49 4.33	8.62 4.34	8.75 4.36	8.89 4.38	9.02 4.39	9.15 4.41	9.28 4.43	9.42 4.45	9.55 4.46	9.68 4.48	3.2
3.3	8.52 4.43	8.65 4.45	8.78 4.46	8.91 4.48	9.05 4.50	9.18 4.51	9.31 4.53	9.44 4.55	9.57 4.57	9.70 4.58	9.84 4.60	3.3
3.4	8.67 4.55	8.80 4.57	8.93 4.58	9.06 4.60	9.20 4.62	9.33 4.63	9.46 4.65	9.59 4.67	9.73 4.69	9.86 4.70	9.99 4.72	3.4
3.5	8.82 4.68	8.96 4.70	9.09 4.71	9.22 4.73	9.35 4.75	9.48 4.76	9.62 4.78	9.75 4.80	9.88 4.82	10.01 4.83	10.15 4.85	3.5
3.6	8.98 4.80	9.11 4.82	9.24 4.83	9.37 4.85	9.50 4.87	9.63 4.88	9.77 4.90	9.90 4.92	10.08 4.94	10.17 4.95	10.30 4.97	3.6
3.7	9.13 4.92	9.26 4.94	9.39 4.95	9.52 4.97	9.65 4.99	9.78 5.00	9.92 5.02	10.05 5.04	10.19 5.06	10.32 5.07	10.46 5.09	3.7
3.8	9.29 5.04	9.42 5.06	9.55 5.07	9.68 5.09	9.81 5.11	9.94 5.12	10.08 5.14	10.21 5.16	10.34 5.18	10.48 5.19	10.61 5.21	3.8
3.9	9.44 5.16	9.57 5.18	9.70 5.19	9.84 5.21	9.97 5.23	10.10 5.24	10.23 5.26	10.36 5.28	10.50 5.30	10.64 5.31	10.77 5.33	3.9
4.0	9.60 5.29	9.73 5.31	9.86 5.32	10.00 5.34	10.13 5.36	10.26 5.37	10.39 5.39	10.53 5.41	10.66 5.43	10.79 5.44	10.93 5.46	4.0
4.1	9.75 5.41	9.88 5.43	10.02 5.44	10.15 5.46	10.28 5.48	10.39 5.49	10.54 5.51	10.68 5.53	10.81 5.55	10.94 5.56	11.08 5.58	4.1

4.2	9.90	10.03	10.17	10.30	10.48	10.57	10.70	10.84	10.97	11.10	11.24	4.2
	5.53	5.55	5.56	5.58	5.60	5.61	5.63	5.65	5.67	5.68	5.70	
4.3	10.06	10.19	10.32	10.45	10.58	10.72	10.85	10.99	11.12	11.25	11.39	4.3
	5.65	5.67	5.68	5.70	5.72	5.73	5.75	5.77	5.79	5.80	5.82	
4.4	10.21	10.34	10.48	10.61	10.74	10.87	11.00	11.14	11.27	11.41	11.55	4.4
	5.77	5.79	5.80	5.82	5.84	5.85	5.87	5.89	5.91	5.92	5.94	
4.5	10.36	10.49	10.63	10.76	10.89	11.03	11.16	11.29	11.42	11.56	11.70	4.5
	5.89	5.91	5.92	5.94	5.96	5.97	5.99	6.01	6.03	6.04	6.06	
4.6	10.52	10.65	10.78	10.92	11.05	11.18	11.31	11.45	11.58	11.71	11.85	4.6
	6.02	6.04	6.05	6.07	6.09	6.10	6.12	6.14	6.16	6.17	6.19	
4.7	10.67	10.81	10.94	11.07	11.20	11.34	11.47	11.60	11.73	11.87	12.01	4.7
	6.14	6.16	6.17	6.19	6.21	6.22	6.24	6.26	6.28	6.29	6.31	
4.8	10.83	10.96	11.09	11.22	11.36	11.49	11.62	11.76	11.89	12.02	12.16	4.8
	.26	6.28	6.29	6.31	6.33	6.34	6.36	6.38	6.40	6.41	6.43	
4.9	10.98	11.11	11.25	11.38	11.51	11.65	11.78	11.91	12.04	12.18	12.32	4.9
	6.38	6.40	6.41	6.43	6.45	6.46	6.48	6.50	6.52	6.53	6.55	
5.0	11.14	11.27	11.40	11.54	11.67	11.80	11.93	12.07	12.20	12.34	12.48	5.0
	6.50	6.52	6.53	6.55	6.57	6.58	6.60	6.62	6.64	6.65	6.67	
5.1	11.29	11.42	11.55	11.69	11.82	11.96	12.09	12.23	12.36	12.49	12.63	5.1
	6.62	6.64	6.65	6.67	6.69	6.70	6.72	6.74	6.76	6.77	6.79	
5.2	11.45	11.58	11.71	11.85	11.98	12.11	12.24	12.38	12.52	12.66	12.80	5.2
	6.74	6.76	6.77	6.79	6.81	6.82	6.84	6.86	6.88	6.89	6.91	
5.3	11.60	11.73	11.86	11.99	12.13	12.27	12.40	12.53	12.67	12.71	12.85	5.3
	6.86	6.88	6.89	6.91	6.93	6.94	6.96	6.98	7.00	7.01	7.03	
5.4	11.76	11.89	12.02	12.16	12.29	12.42	12.55	12.69	12.83	12.97	13.01	5.4
	6.98	7.00	7.01	7.03	7.05	7.06	7.08	7.10	7.12	7.13	7.15	
5.5	11.91	12.04	12.17	12.31	12.44	12.58	12.71	12.85	12.99	13.12	13.25	5.5
	7.10	7.12	7.13	7.15	7.17	7.18	7.20	7.22	7.24	7.25	7.27	
5.6	12.07	12.20	12.33	12.47	12.60	12.73	12.87	13.00	13.14	13.28	13.41	5.6
	7.23	7.25	7.26	7.28	7.30	7.31	7.33	7.35	7.37	7.38	7.40	
5.7	12.22	12.35	12.48	12.52	12.75	12.89	13.02	13.16	13.30	13.44	13.57	5.7
	7.35	7.37	7.38	7.40	7.42	7.43	7.45	7.47	7.49	7.50	7.52	
5.8	12.38	12.51	12.64	12.77	12.91	13.05	13.18	13.31	13.45	13.59	13.72	5.8
	7.47	7.49	7.50	7.52	7.54	7.55	7.57	7.59	7.61	7.62	7.64	
5.9	12.53	12.66	12.79	12.93	13.06	13.19	13.33	13.47	13.60	13.74	13.87	5.9
	7.59	7.61	7.62	7.64	7.66	7.67	7.69	7.71	7.73	7.74	7.76	
6.0	12.69	12.82	12.95	13.09	13.22	13.35	13.49	13.62	13.75	13.89	14.02	6.0
	7.71	7.73	7.74	7.76	7.78	7.79	7.81	7.83	7.85	7.86	7.88	

SYNOPSIS OF MANUFACTURE OF PRINCIPAL VARIETIES OF CHEESE. (McConnell.)

	Evening's Milk Cooled to	Rennetted at	Time Allowed for Coagulation	Temperature in Cooking.	Breaking or Stirring.	Acid Developed.	Salt Added.	Pressure Applied.	Ripened at	Mold.	Shape of Cheese.	Weight of Cheese.	Remarks.
	° F.	° F.	Min.	° F	Min.				° F			lbs.	
Cheddar...........	68	84	45	100	100	Much	1:56	1 ton	60	.....	Deep	60–80	
Cheshire—													
Early ripening...	70	80	50	90	30	V'ry much	1:25	15 cwt	60	..	"	80	50% more rennet used; sk ·ered; sour whey added, 1:120.
Medium " ...	68	87	60	92	40	Medi'm	1:30	Graduated	60	......	"	80	Dried in oven at o–80° F.
Late " ...	66	90	70	94	40	Little	1:35	"	60	.....	"	80	" " " " "
Stilton...........	65	86	45	None	Little	"	1:40	56 lbs.	60	Green	"	20	Open, flaky curd desired; extra r nn.
Stilton.............	65	85	60–150	"	Very little	"	1:60	None	65	Blue	"	15	Extra cream added, or ½ skim drawn off.
Gloucester (single and double).....	65	80	60	84	"	"	Outside	Graduated	65	"	Flat	5&30	Partly skim-milk; painted brown · differ n in thickness.
Wilts Loaf.........	65	80	60	90	Little	"	1:56	"	65	....	Deep	30	Partly skim-milk.
Derby..	63	80	60	None	"	None	Outside	"	63	Blue	Flat	30	" sweet curd.
Leicester...........	65	82	70	84	20	Little	1:160	"	65	.....	"	40	
Dunlop.............	65	80	60	None	60	None	1:56	"	60	.....	Medi'm	56	No scalding; curd broken by hand.
Brie.................	......	83	240	"	None	"	Outside	None	50	Blue	Flat	4–5	Drained in open moulds.
Camembert.........	......	86	240	"	"	"	"	"	50	White	Deep	1	Drained in open moulds; ripe in six weeks.
Cantal.	.....	75	60	"	15	"	Little	Much	46	.....	Flat	40–100	Ripe in two months.
Coulommiers	......	78	720	"	None	"	None	None	...	Green	"	2½	Drained in open moulds.
Gervais (cream)....	.....	65	720	"	"	"	"	"	...	.....	Deep	¼	Drained in cloth; 1 cream to 2 milk; 1 drop rennet to quart of milk.
Gorgonzola........	......	90	20	"	"	"	Outside	"	46	Blue	"	40–60	Drained in cloths.
Parmesan..........	......	92	45	130	40	Medi'm	"	Little	50	.....	Flat	150	Ripens in three years.

THE CHEESE MARKET OF THE UNITED STATES.

(THOM.)

Hard Cheeses.	Milk.	Yield of Cheese per 100lbs. Milk	Ripening.
English cheddar (best)	Whole milk	9–11	6–12 mo.
Canadian or American cheddar	Whole milk	9–11	3–12 mo.
Edam	Low fat	8–11	Long period
Swiss	Low fat	8–11	Long period
Parmesan	Low fat	8–11	2–3 years
SOFT OR FANCY CHEESES.			
Camembert	3.5–4% fat	12–15	4 weeks
Gorgonzola	Whole milk	9–11	4 months
Stilton (best)	Whole milk	8–10	3–6 months
Amer. "Neufchatel" and Cream	Mostly poor in fat	12–14 (?)	Eaten fresh

Hard Cheeses.	Market-able Period.	Retail Price per Pound.	
		Europe.	U. S.
English cheddar (best)	6 mo. or more	\$0.22–26	....
Canadian or American cheddar	Months	0.15*	0.14–18
Edam	Very long	0.15–24	0.33
Swiss	Very long	0.24–28	0.26–35
Parmesan	Very long	0.32	....
SOFT OR FANCY CHEESES.			
Camembert	10 days	0.26–36	0.50–70
Gorgonzola	1–2 mo.	0.23–24	0.45
Stilton (best)	2 mo. (?)	0.25–35	0.45–60
Amer. "Neufchatel" and Cream	Few days	....	0.20–60

* London, October, 1905.

COMMERCIAL GRADES OF AMERICAN CHEDDAR CHEESE. (ONTARIO DEPT. OF AGRICULTURE.)

FIRST GRADE.—*Flavor.*—Clean, sound, and pure.

Body and Texture.—Close, firm, and silky.

Color.—Good and uniform.

Finish.—Fairly even in size, smoothly finished, sound and clean surfaces, straight, and square.

Boxes.—Strong, clean, well made, and nailed. Ends to be of seasoned timber. Close fitting. Weights stenciled or marked with rubber stamp.

SECOND GRADE.—*Flavor.*—"Fruity," not clean, "turnipy," or other objectionable flavor.

Body and Texture.—Weak, open, loose, "acidy," too soft, too dry.

Color.—Uneven, mottled, or objectionable shade.

Finish.—Very uneven in size, showing rough corners, black mold, dirty or cracked surfaces, soft rinds.

Boxes.—Too large in diameter; top edge of box more than ½ an inch below the top of the cheese. Made of light material. Ends made of improperly seasoned material.

THIRD GRADE.—*Flavor.*—Rancid, badly "off," anything inferior to Second Grade.

Body and Texture.—Very weak, very open, showing pinholes or porous, very "acidy," very soft or very dry.

Color.—Badly mottled, or very objectionable shade.

Finish.—Anything worse than second grade.

Boxes.—No question of boxes sufficient to make Third Grade if other qualities are good.

EXPLANATIONS.—It would be impossible to define exactly the qualities or defects which may appear in cheese. The standards given are intended to indicate the range of quality for the different grades rather than to establish hard and fast rules to guide the grader.

The expression "good color" means that the color must be of proper shade. There are cheap, inferior cheese colors used which do not give the proper shade, no matter what quality is used.

The expression "clean surfaces" in the definition for First Grade does not exclude from that grade cheese with a slight growth of blue mold, although it is desirable that the cheese should not show any signs of mold. "Black mold" (see definition for Second Grade), is simply the advanced stage of the ordinary blue mold.

The following *scale of points* will indicate the relative values of the different divisions of quality: Flavor, 40; body and texture, 30; color, 15; finish and boxing, 15; =100.

It is obvious that a defect in flavor of a certain degree counts nearly three times as much in determining the grade as a defect in finish or boxing of the same grade.

Cheese which are strictly sour, or otherwise inferior to Third Grade, will be designated as "*Culls*," for which there is no classification.

Any lot of cheese shall be considered third grade if it shows three or more defects of Second Grade class.

If there are not more than 15 per cent of defective cheese in any lot, the inferior ones may be sorted out and classed separately. If more than 15 per cent are defective, the classification for the defective cheese may apply to the whole lot.

This does not apply when inferior cheese have been properly marked so as to be identified, in which case the inferior cheese shall be treated as a separate lot.

WHEY TO BE ALLOWED AT CHEESE FACTORIES FOR QUANTITIES OF MILK FROM 30 TO 360 POUNDS. (ROBERTSON.)

The figures in the columns denote the inches of whey.

Weight of Milk in Pounds.	Diameters of Milk-cans in Inches.								
	20	19	18	17	16	15	14	13	12
30	2	2	3	3	3	3	4	5	6
35	2	3	3	3	3	4	5	6	7
40	3	3	3	4	4	5	6	6	7
45	3	4	4	4	4	5	6	7	8
50	3	4	4	5	5	6	7	8	9
55	4	4	5	5	6	7	8	9	10
60	4	5	5	6	6	7	8	9	11
65	4	5	5	6	7	8	9	10	12
70	5	5	6	7	7	8	10	11	13
75	5	6	6	7	8	9	10	12	14
80	5	6	7	8	8	10	11	12	15
85	6	6	7	8	9	10	12	13	16
90	6	7	7	9	9	11	12	14	17
95	6	7	8	9	10	11	13	15	18
100	7	7	8	9	10	12	14	16	19
105	7	8	9	9	11	13	15	16	19
110	7	8	9	10	11	13	15	17	20
115	8	9	10	10	12	14	16	18	21
120	8	9	10	11	12	14	17	19	22
125	8	9	10	11	13	15	17	19	23
130	9	10	11	12	13	16	18	20	24
135	9	10	11	12	14	16	19	21	
140	9	10	12	13	14	17	20	22	
145	10	11	12	13	15	17	20	23	
150	10	11	12	14	15	18	21	24	
155	10	11	13	15	16	19	22		
160	11	12	13	15	16	19	22		
165	11	12	14	16	17	20	23		
170	11	12	14	16	17	20	23		
175	12	13	15	16	18	21	24		
180	12	13	15	17	18	22	24		
185	12	14	15	17	19	22			
190	13	14	16	18	19	23			
195	13	14	16	18	20	23			
200	13	15	17	18	20	24			
205	14	15	17	19	21				
210	14	16	18	19	21				
215	14	16	18	20	22				
220	15	16	18	20	23				
225	15	17	19	21	24				
230	15	17	19	21	24				
235	16	18	19	22					
240	16	18	20	22					
245	16	18	20	23					
250	17	19	21	23					
260	17	19	22	24					
270	18	20	22						
280	19	21	23						
290	19	22	24						
300	20	23	24						
310	21	23							
320	21	24							
330	22								
340	23								
350	23								
360	24								

VI. MANAGEMENT OF CREAMERIES AND CHEESE FACTORIES.

DIRECTIONS FOR TAKING AND PRESERVING COMPOSITE SAMPLES OF MILK IN CREAMERIES AND CHEESE-FACTORIES. (FARRINGTON).

The modern creamery and cheese-factory uses the Babcock test for determining the quality of the milk delivered by each patron. The most common and satisfactory method of paying for the milk according to its test is to take a small sample of each lot of milk each day, pour this into a covered glass jar containing a small amount of some preservative, and at the end of a week or ten days test this composite sample. The essential features of the process are given in the following directions:

1. Provide a pint or quart jar or bottle for each patron.

2. Label each bottle with a number, giving the same number to a patron on the milk-recording sheet.

3. Composite-test sample-bottles made for this purpose with a tin cover and numbered brass tag wired to the neck of each bottle can be obtained of creamery supply-firms.

4. These sample-bottles should be placed on shelves within easy reach of the man at the weigh-can, and protected from the light.

5. A small quantity of powdered potassium bichromate, corrosive sublimate, formaldehyd, borax, or preservaline is put into each clean bottle, to keep the milk from souring until testing-day. Some of these preservatives are put up in tablet form, each tablet containing the necessary amount to use in one sample.

6. After each lot of milk is poured into the factory weigh-can and weighed, a small amount of it is dipped from the can and poured into the proper sample-bottle.

7. These samples are usually taken with a small (1-oz.)

tin dipper, a Scovell sampling-tube, or from a drip in the conductor-spout.

8. Each lot of milk sampled must be sweet, containing no clots, lumps of curdled milk, or small butter-granules. The sample should be taken just as soon as the milk is weighed, and while it is evenly mixed.

9. The use of a small (1-oz.) tin dipper for taking the composite sample has been proved to be practically correct. As the quantities of milk delivered from day to day by each patron vary but little, the error introduced by taking the same amount of milk for each sample is too small to be worth considering in factory work, and this method of composite sampling is usually adopted in separator creameries and in cheese-factories, where the payment of the milk is based on its quality.

10. When it is desired to vary the size of the samples according to the quantity of milk delivered each day by a patron, it is necessary to use a "milk-thief" or a Scovell sampling-tube. In using either of these tubes, the size of the sample is regulated by the amount of milk in the weigh-can. In all cases cylindrical sampling-cans must be used.

11. Continue adding a sample of each patron's milk to his particular jar every time he delivers milk, for a week or ten days; then test this composite sample.

12. The composite sample-jars should be kept covered, to prevent loss by evaporation, and in a cool, dark place. Every time a new portion of milk is added to the jar it should be given a horizontal rotary motion to mix the cream already formed in the jar with the milk, and to rinse off the cream sticking to its side. Unless this is done every time fresh portions of milk are added to the jar the cream on the milk becomes lumpy and sticks in patches to the side of the jar, thus making it nearly impossible to evenly distribute this cream through the entire sample.

13. Composite samples having patches of dried cream on the inside of the jar are the result of carelessness or ignorance on the part of the operator.

14. A test of the composite sample takes the place of the daily tests of each lot of milk and gives accurate informa-

tion regarding the average quality of the milk delivered by each patron during the period of sampling.

15. The weight of butter-fat which each patron brought to factory in his milk during the time covered by the sampling is obtained by multiplying the total weight of milk delivered during the sampling period by the test of the composite sample, divided by 100.

PAYMENT OF MILK AT CREAMERIES AND CHEESE FACTORIES.*

Numerous systematic and extensive experiments by various scientists have proved that the value of milk for both butter and cheese production stands in direct proportion to its fat content. Patrons of separator cheese and butter factories should therefore receive payment for the milk delivered by them according to the percentage of fat in the milk, i.e., according to the quantity of fat delivered in their milk. The same applies to gathered-cream factories as well.

The tables given on pp. 305–306 will aid in the calculation of the value of milks of different richness, according to prices agreed upon. In paying for the milk delivered by patrons, four, or, essentially, three, different methods are followed at different factories, all of which are just to all parties concerned. The methods and the directions for using the tables in each case are given below. The tables and discussions entered upon are largely taken from Vermont Experiment Station Bulletin No. 16.

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* See *Farrington-Woll*, Testing Milk and its Products, 22d Ed., pp. 203–216, 286–289.

METHODS OF PAYMENT FOR MILK AT CHEESE AND BUTTER FACTORIES.

1. *A certain price is to be paid per one hundred lbs. of milk containing a definite per cent of fat* (e.g., $1.00 per 100 lbs. of four per cent milk). By referring to the second half of the table on p. 271 we find $1.00 opposite 4.00 per cent of fat; the figures in the same column as $1.00 then give the value of 100 lbs. of milk containing percentages of fat ranging from 3.00 to 5.00; e.g., 100 lbs. of 3 per cent milk is worth 75 cents, of 4.5 per cent milk $1.13, of 5.40 per cent milk $1.35, etc.

2. *A certain price is to be paid per pound of fat delivered.* If 21 cents is the price agreed upon we multiply .21 by three, and the product, .63, gives the amount in dollars to be paid per 100 lbs. of three per cent milk. The column in which the figure .63 occurs opposite 3.0 per ct. is then to be used in the calculations as long as the price is paid, and 3.5 per cent milk will be paid with 73 cents per 100 lbs., 5.3 per ct. milk $1.10 per 100 lbs., etc.

Example: Patron A delivers 840 lbs. of milk during one week, containing, according to the test made, 4.3 per cent fat. If the price agreed upon per pound of fat was as before stated, he is to receive 90 cents per 100 lbs. of milk, or $7.56 in all.

Patron B, sending 625 lbs. of milk testing 3.45 per cent, will receive 6.25 × .72 = $4.50, etc. In the table only tenths of per cents are given; 3.45 being half-way between 3.40 and 3.50, for which percentages 71 and 73 cents are to be paid respectively, we multiply by the mean of the two values, or .72. If a test differs less than five-hundredths from any percentages given in the table, the nearest figure is chosen.

3. *Patrons are to be paid what is received for the butter, less a certain amount for cost of making and marketing.* Multiply each man's milk by the per cent of fat it contains, and the sum of the several products will be the total amount of fat contained in the day's milk. Divide the pounds of butter made from the milk by the pounds of fat it contained, to

find how much butter each pound of fat makes. Multiplying the amount received per pound of butter, less the cost of making, etc., by this last result will give the amount to be paid for each pound of fat delivered.

Example: Suppose the patrons furnish milk containing in all 400 lbs. of fat, which made 460 lbs. of butter, selling for 27 cents per pound. The expense of making the butter is found to be, e.g., 4 cents per pound. $27-4=23$ cents; 460 divided by 400 equals 1.15; 23 multiplied by 1.15 equals 26.45, which is the amount, in cents, to be paid per pound of fat delivered; $26.45 \times 3 = 79.35$, or nearest 79 cents, is then the money to be paid for 100 lbs. of 3 per cent milk, and (see table) 90 cents for 100 lbs. of 3.40 per cent milk, $1.24 for 100 lbs. of 4.7 per cent milk, etc.

4. *A certain price is to be paid per* 100 *lbs. of milk of average quality.* Find the total fat contained in the milk as before; divide this amount by the total weight of milk delivered, and the result will be the average per cent of fat in the milk. Starting from this per cent at the left of the table, go to the right until the price per 100 lbs. agreed upon is reached; the perpendicular column in which this figure is found is the one to be used. *Example:* Suppose milk of average quality is to be paid $1.00 per hundred pounds, and the farmers furnish 8500 lbs. of milk, containing in all 440 lbs. of fat; 440 divided by 85.00 then equals 5.18, the number nearest to which in the table is 5.20 per cent. To the right of 5.20 per cent $1.00 is found in the column headed .58, which column would be the one to use.

PRICE OF MILK OF DIFFERENT RICHNESS PER 100 POUNDS.

P. ct. Fat.	Price per 100 lbs. of Milk, in dollars and cents.								
3.00	1.00	.97	.94	.91	.88	.86	.83	.81	.79	.77
3.10	1.03	1.00	.97	.94	.91	.89	.86	.84	.82	.79
3.20	1.07	1.03	1.00	.97	94	.91	.89	.86	.85	.82
3.30	1.10	1.07	1.03	1.00	.97	.94	.92	.89	.87	.84
3.40	1.13	1.10	1.06	1.03	1.00	.97	.94	.92	.90	.87
3.50	1. 7	1.13	1.09	1.06	1.03	1.00	.97	.95	.93	.89
3.60	1.20	1.16	1.12	1.09	1.06	1.03	1.00	.97	.95	.92
3.70	1.23	1.19	1.16	1.12	1.09	1.06	1.03	1.00	.98	.94
3.80	1.27	1.23	1.19	1.15	1.12	1.09	1.06	1.03	1.00	.97
3.90	1.30	1.26	1.22	1.18	1.15	1.11	1.08	1.06	1.03	1.00
4.00	1.33	1.29	1.25	1.21	1.18	1.14	1.11	1.08	1.06	1.02
4.10	1.37	1.32	1.28	1.24	1.21	1.17	1.14	1.11	1.08	1.05
4.20	1.40	1.35	1.31	1.27	1.24	1.20	1.17	1.14	1.11	1.07
4.30	1.43	1.39	1.34	1.30	1.26	1.23	1.19	1.17	1.14	1.10
4.40	1.47	1.42	1.38	1.33	1.29	1.26	1.22	1.19	1.16	1.12
4.50	1.50	1.45	1.41	1.36	1.32	1.29	1.25	1.22	1.19	1.15
4.60	1.53	1.48	1.44	1.39	1.35	1.31	1.28	1.25	1.21	1.17
4.70	1.57	1.52	1.47	1.42	1.38	1.34	1.31	1.28	1.24	1.20
4.80	1.60	1.55	1.50	1.45	1.41	1.37	1.33	1.30	1.27	1.23
4.90	1.63	1.58	1.53	1.48	1.44	1.40	1.36	1.33	1.29	1.25
5.00	1.67	1.61	1.56	1.52	1.47	1.43	1.39	1.36	1.32	1.28
5.10	1.70	1.65	1.59	1.55	1.50	1.46	1.42	1.39	1.35	1.30
5.20	1.73	1.68	1.63	1.58	1.53	1.49	1.44	1.41	1.37	1.33
5.30	1.77	1.71	1.66	1.61	1.56	1.51	1.47	1.44	1.40	1.35
5.40	1.80	1.74	1.69	1.64	1.59	1.54	1.50	1.47	1.42	1.38
5.50	1.83	1.77	1.72	1.67	1.62	1.57	1.53	1.50	1.45	1.41
5.60	1.87	1.81	1.75	1.70	1.65	1.60	1.56	1.52	1.48	1.44
5.70	1.90	1 84	1.78	1.73	1 68	1.63	1.58	1.55	1.50	1.46
5.80	1.93	1.87	1.81	1.76	1.71	1.66	1.61	1.57	1.53	1.49
5.90	1.97	1.90	1.84	1.79	1.74	1.69	1.64	1.60	1.56	1.51
6.00	2.00	1.94	1.88	1.82	1.76	1.71	1.67	1.62	1.58	1.54

3.00	.75	.73	.71	.70	.68	.67	.65	.64	.63	.61
3.10	.78	.75	.73	.72	.70	.69	.67	.66	.65	.63
3.20	.80	.78	.76	.75	.73	.71	.69	.68	.67	.65
3.30	.83	.80	.78	.77	.75	.74	.72	.70	.69	.67
3.40	.85	.83	.81	.79	.77	.76	.74	.73	.71	.69
3.50	.88	.85	.83	.82	.79	.78	.76	.75	.73	.71
3.60	.90	.88	.85	.84	.82	.80	.78	.77	.75	.73
3.70	.93	.90	.88	.86	.84	.83	.80	.79	.77	.75
3.80	.95	.93	.90	.89	.86	.85	.82	.81	.80	.77
3.90	.98	.95	.92	.91	.88	.87	.85	.83	.82	.79
4.00	1.00	.97	.95	.93	.91	.89	.87	.85	.84	.81
4.10	1.03	1.00	.97	.96	.93	.91	.89	.87	.86	.83
4 20	1.05	1.02	1.00	.98	.95	.94	.91	.90	.88	.85
4.30	1.08	1.05	1.02	1.00	.98	.96	.93	.92	.90	.88
4.40	1.10	1.07	1.05	1.02	1.00	.98	.95	.94	.92	.90

PRICE OF MILK PER 100 POUNDS.—*Continued.*

P. ct. Fat.	Price per 100 lbs. of Milk, in dollars and cents.								
4.50	1.13	1.10	1.07	1.05	1.02	1.00	.97	.96	.94	.92
4.60	1.15	1.12	1.10	1 07	1.05	1.02	1.00	.98	.96	.94
4.70	1.18	1.15	1.12	1.09	1.07	1.04	1.02	1.00	.98	.96
4.80	1.20	1.17	1.14	1.12	1.09	1.07	1.07	1.02	1.00	.98
4.90	1.23	1.20	1.17	1.14	1.11	1.09	1.07	1.04	1.02	1.00
5.00	1.25	1.22	1.19	1.16	1.14	1.11	1.09	1.06	1.04	1.02
5.10	1.28	1.24	1.21	1.19	1.16	1.13	1.11	1.09	1.06	1.04
5.20	1.30	1.27	1.24	1.21	1.18	1.16	1.13	1.11	1.08	1.06
5.30	1.33	1.29	1.26	1.23	1.20	1.18	1.15	1.13	1.10	1.08
5.40	1.35	1.32	1.29	1.26	1.23	1.20	1.17	1.15	1.12	1.10
5.50	1.38	1.34	1.31	1.28	1.25	1.22	1.20	1.17	1.14	1.12
5.60	1.40	1.37	1.34	1.30	1.27	1.24	1.22	1 19	1.17	1.14
5.70	1.43	1.39	1.36	1.33	1.30	1.27	1.24	1.21	1.19	1.16
5.80	1.45	1.41	1.39	1.35	1.32	1.29	1.26	1.23	1.21	1.18
5.90	1.48	1.44	1.41	1.38	1.34	1.31	1.28	1.26	1.23	1.20
6.00	1.50	1.46	1.43	1.40	1.36	1.33	1.30	1.28	1.25	1.22

3.00	.60	.59	.58	.57	.56	.55	.54	.53	.52	.51	.50
3.10	.62	.61	.60	.59	.58	.57	.56	.55	.54	.53	.52
3.20	.64	.63	.62	.61	.60	.59	.58	.57	.55	.54	.53
3.30	.66	.65	.64	.63	.62	.60	.59	.58	.57	.56	.55
3.40	.68	.67	.66	.65	.63	.62	.61	.60	.59	.58	.57
3.50	.70	.69	.68	.66	.65	.64	.63	.62	.61	.59	.58
3.60	.72	.71	.70	.68	.67	.66	.65	.64	.62	.61	.60
3.70	.74	.73	.71	.70	.69	.68	.67	.65	.64	.63	.62
3.80	.76	.75	.73	.72	.71	.70	.68	.67	.66	.65	.63
3.90	.78	.77	.75	.74	.73	.71	.70	.69	.67	.66	.65
4.00	.80	.79	.77	.76	.75	.73	.72	.71	.69	.68	67
4.10	.82	.81	.79	.78	.76	.75	.74	.72	.71	.70	.68
4.20	.84	.83	.81	.80	.78	.77	.75	.74	.73	.71	.70
4.30	.86	.84	.83	.82	.80	.79	.77	.76	.74	.73	.72
4.40	.88	.86	.85	.83	.82	.80	.79	.78	.76	.75	.73
4.50	.90	.88	.87	.85	.84	.82	.81	.79	.79	.76	.75
4.60	.92	.90	.89	.87	.86	.84	.83	.81	.80	.78	.77
4.70	.94	.92	.91	.89	.88	.86	.84	.83	.81	.80	.78
4.80	.96	.94	.93	.91	.90	.88	.86	.85	.83	.81	.80
4.90	.98	.96	.94	.93	.91	.90	.88	.86	.85	.83	.82
5.00	1.00	.98	.96	.95	.93	.91	.90	.88	.86	.85	.83
5.10	1.02	1.00	.98	.96	.95	.93	.92	.90	.88	.86	.85
5.20	1.04	1.02	1.00	.98	.97	.95	.93	.92	.90	.88	.87
5.30	1.06	1.04	1.02	1.00	.99	.97	.95	.93	.92	.90	.88
5 40	1.08	1.06	1.04	1.02	1.00	.99	.97	.95	.93	.92	.90
5.50	1.10	1.08	1.06	1.04	1.02	1.00	.99	.97	.95	.93	.92
5.60	1.12	1.10	1.08	1.06	1.04	1.02	1.00	.98	.97	.95	.93
5.70	1.14	1.12	1.10	1.08	1.06	1.04	1.02	1.00	.98	.97	.95
5.80	1.16	1.14	1.12	1.09	1.07	1.05	1.04	1.02	1.00	.98	.97
5.90	1.18	1.16	1.13	1.11	1.09	1.07	1 05	1.04	1.02	1.00	.98
6.00	1.20	1.18	1.15	1.13	1.11	1.09	1.07	1.05	1.03	1.02	1.00

DIRECTIONS FOR MAKING DIVIDENDS IN CREAMERIES AND CHEESE FACTORIES

According to the Per Cent of Fat in Milk Delivered.

(S. M. Babcock, in "Hoard's Dairyman.")

Find the amount of fat contained in the milk of each patron for any period desired, by multiplying the pounds of milk expressed in hundreds by the per cent of fat found by the test. Add together the amount of fat from all the patrons, thus obtaining the total pounds of fat delivered at the factory. Deduct the expenses of manufacture, etc., from the money received from sales, and divide the remainder by the total fat. This gives the price to be paid for each pound of fat. Multiply the pounds of fat delivered by each patron by the price; the product will be the amount which he is to receive.

If it is desired to know the number of pounds of butter made from each patron's milk, divide the total yield of butter by the total fat delivered; the quotient will be the amount of butter made from one pound of fat. The fat delivered by each patron multiplied by this figure will give the pounds of butter to be credited to each patron.

The accompanying table gives the butter yield from 100 lbs. of milk, when the pounds of butter from one pound of fat range from 1.10 to 1.20, and for milks containing from 3 to 6 per cent of fat. To use the table find in the upper horizontal line the number corresponding most nearly to the number of pounds of butter from one pound of fat. The vertical column in which this falls gives the pounds of butter from 100 pounds of milk containing the per cents of fat given in the outside columns.

Example: A creamery receives during one month 250,000 lbs. of milk, which contained 9531 lbs. of fat; the yield of butter for the same period was 10,983 lbs., which sold for 29 cents per pound, bringing $3185.07. The expense for making, etc., was four cents per pound, amounting to $439.32, leaving $2745.75 to be divided among the patrons. Dividing this sum by 9531, the total number of pounds of fat gives 28.8 cents per pound for the fat. This multiplied by the number of pounds of fat in each patron's milk gives the amount which he should be paid.

The number of pounds of butter, 10,983, divided by 9531, the number of pounds of fat, gives 1.152 pounds of butter from each pound of fat. The column headed 1.15 in the table is nearest to this ratio, and will therefore give the butter obtained from 100 lbs. of milk containing different per cents of fat.

If a patron delivered 9420 lbs. of milk containing 3.2 per cent of fat during the period considered, his milk would have contained 301.44 lbs. of fat, which at 28.8 cents per pound would have amounted to $86.81. It would have made 301.44 × 1.152 = 347.26 lbs. of butter. In the column headed 1.15 in the table, opposite 3.2 per cent of fat, we find 3.68, which is the number of pounds of fat from 100 lbs. of this patron's milk. The error from the use of the table in this way will never amount to more than ¼ ounce per 100 lbs. of milk.

Yield of Butter from One Hundred Lbs. of Milk, in Lbs.

Per cent Fat	Lbs. of Butter per Pound of Fat.											Per cent Fat.
	1.10	1.11	1.12	1.13	1.14	1.15	1.16	1.17	1.18	1.19	1.20	
3.0	3.30	3.33	3.36	3.39	3.42	3.45	3.48	3.51	3.54	3.57	3.60	3.0
3.1	3.41	3.441	3.472	3.503	3.534	3.565	3.596	3.627	3.658	3.689	3.72	3.1
3.2	3.52	3.552	3.584	3.616	3.648	3.680	3.712	3.744	3.776	3.808	3.84	3.2
3.3	3.63	3.663	3.696	3.729	3.762	3.795	3.828	3.861	3.894	3.927	3.96	3.3
3.4	3.74	3.774	3.808	3.842	3.876	3.910	3.944	3.978	4.012	4.046	4.08	3.4
3.5	3.85	3.885	3.920	3.955	3.990	4.025	4.060	4.095	4.130	4.165	4.20	3.5
3.6	3.96	3.996	4.032	4.068	4.104	4.140	4.176	4.212	4.248	4.284	4.32	3.6
3.7	4.07	4.107	4.144	4.181	4.218	4.255	4.292	4.329	4.366	4.403	4.44	3.7
3.8	4.18	4.218	4.256	4.294	4.332	4.370	4.408	4.446	4.484	4.522	4.56	3.8
3.9	4.29	4.329	4.368	4.407	4.446	4.485	4.524	4.563	4.602	4.641	4.68	3.9
4.0	4.40	4.440	4.480	4.520	4.560	4.600	4.640	4.680	4.720	4.760	4.80	4.0
4.1	4.51	4.551	4.592	4.633	4.674	4.715	4.756	4.797	4.838	4.879	4.92	4.1
4.2	4.62	4.662	4.704	4.746	4.758	4.830	4.872	4.914	4.956	4.998	5.04	4.2
4.3	4.73	4.773	4.816	4.859	4.902	4.945	4.988	5.031	5.074	5.117	5.16	4.3
4.4	4.84	4.884	4.928	4.972	5.016	5.060	5.104	5.148	5.192	5.236	5.28	4.4
4.5	4.95	4.995	5.040	5.085	5.130	5.175	5.220	5.265	5.310	5.355	5.40	4.5
4.6	5.06	5.106	5.152	5.198	5.244	5.290	5.336	5.382	5.428	5.474	5.52	4.6
4.7	5.17	5.217	5.264	5.311	5.358	5.405	5.452	5.499	5.546	5.543	5.64	4.7
4.8	5.28	5.328	5.376	5.424	5.472	5.520	5.568	5.616	5.664	5.712	5.76	4.8
4.9	5.39	5.439	5.488	5.537	5.586	5.635	5.684	5.733	5.782	5.831	5.88	4.9
5.0	5.50	5.550	5.600	5.650	5.700	5.750	5.800	5.850	5.900	5.950	6.00	5.0
5.1	5.61	5.661	5.712	5.763	5.814	5.865	5.916	5.967	6.018	6.069	6.12	5.1
5.2	5.72	5.772	6.824	5.876	5.928	5.980	6.032	6.084	6.136	6.188	6.24	5.2
5.3	5.83	5.883	5.936	5.989	6.042	6.095	6.148	6.201	6.254	6.307	6.36	5.3
5.4	5.94	5.994	6.048	6.102	6.156	6.210	6.264	6.318	6.372	6.426	6.48	5.4
5.5	6.05	6.105	6.160	6.215	6.270	6.325	6.380	6.435	6.490	6.545	6.60	5.5
5.6	6.16	6.216	6.272	6.328	6.384	6.440	6.496	6.552	6.608	6.664	6.72	5.6
5.7	6.27	6.327	6.384	6.441	6.498	6.555	6.612	6.669	6.726	6.783	6.84	5.7
5.8	6.38	6.438	6.496	6.554	6.612	6.670	6.728	6.786	6.844	6.902	6.96	5.8
5.9	6.49	6.549	6.608	6.667	6.726	6.785	6.844	6.903	6.962	7.021	7.08	5.9
6.0	6.60	6.660	6.720	6.780	6.840	6.900	6.960	7.020	7.080	7.140	7.20	6.0

TABLE SHOWING AVERAGE PER CENT OF FAT IN MILK. (Partly after MARTINY.)

Sum of 5 Tests.	Sum of 4 Tests.	Sum of 3 Tests.	Av. Per Cent of Fat.	Sum of 5 Tests.	Sum of 4 Tests.	Sum of 3 Tests.	Av. Per Cent of Fat.	Sum of 5 Tests.	Sum of 4 Tests.	Sum of 3 Tests.	Av. Per Cent of Fat.
14.50	11.60	8.70	**2.90**	16.50	13.20	9.90	**3.30**	18.50	14.80	11.10	**3.70**
55	64	73	91	55	24	93	31	55	84	13	71
60	68	76	92	60	28	96	32	60	88	16	72
65	72	79	93	65	32	99	33	65	92	19	73
70	76	82	94	70	36	10.02	34	70	96	22	74
14.75	11.80	8.85	**2.95**	16.75	13.40	10.05	**3.35**	18.75	15.00	11.25	**3.75**
80	84	88	96	80	44	08	36	80	04	28	76
85	88	91	97	85	48	11	37	85	08	31	77
90	92	94	98	90	52	14	38	90	12	34	78
95	96	97	99	95	56	17	39	95	16	37	79
15.00	12.00	9.00	**3.00**	17.00	13.60	10.20	**3.40**	19.00	15.20	11.40	**3.80**
05	04	03	01	05	64	23	41	05	24	43	81
10	08	06	02	10	68	26	42	10	28	46	82
15	12	09	03	15	72	29	43	15	32	49	83
20	16	12	04	20	76	32	44	20	36	52	84
15.25	12.20	9.15	**3.05**	17.25	13.80	10.35	**3.45**	19.25	15.40	11.55	**3.85**
30	24	18	06	30	84	38	46	30	44	58	86
35	28	21	07	35	88	41	47	35	48	61	87
40	32	24	08	40	92	44	48	40	52	64	88
45	36	27	09	45	96	47	49	45	56	67	89
15.50	12.40	9.30	**3.10**	17.50	14.00	10.50	**3.50**	19.50	15.60	11.70	**3.90**
55	44	33	11	55	04	53	51	55	64	73	91
60	48	36	12	60	08	56	52	60	68	76	92
65	52	39	13	65	12	59	53	65	72	79	93
70	56	42	14	70	16	62	54	70	76	82	94
15.75	12.60	9.45	**3.15**	17.75	14.20	10.65	**3.55**	19.75	15.80	11.85	**3.95**
80	64	48	16	80	24	68	56	80	84	88	96
85	68	51	17	85	28	71	57	85	88	91	97
90	72	54	18	90	32	74	58	90	92	94	98
95	76	57	19	95	36	77	59	95	96	97	99
16.00	12.80	9.60	**3.20**	18.00	14.40	10.80	**3.60**	20.00	16.00	12.00	**4.00**
05	84	63	21	05	44	83	61	05	04	03	01
10	88	66	22	10	48	86	62	10	08	06	02
15	92	69	23	15	52	89	63	15	12	09	03
20	96	72	24	20	56	92	64	20	16	12	04
16.25	13.00	9.75	**3.25**	18.25	14.60	10.95	**3.65**	20.25	16.20	12.15	**4.05**
30	04	78	26	30	64	98	66	30	24	18	06
35	08	81	27	35	68	11.01	67	35	28	21	07
40	12	84	28	40	72	04	68	40	32	24	08
45	16	87	29	45	76	07	69	45	36	27	09

TABLE SHOWING AVERAGE PER CENT OF FAT IN MILK.—(*Continued.*)

Sum of			Av. Per Cent of Fat.	Sum of			Av. Per Cent of Fat.	Sum of			Av. Per Cent of Fat.
5 Tests.	4 Tests.	3 Tests.		5 Tests.	4 Tests.	3 Tests.		5 Tests.	4 Tests.	3 Tests.	
20.50	16.40	12.30	**4.10**	22.50	18.00	13.50	**4.50**	24.50	19.60	14.70	**4.90**
55	44	33	11	55	04	53	51	55	64	73	91
60	48	36	12	60	08	56	52	60	68	76	92
65	52	39	13	65	12	59	53	65	72	79	93
70	56	42	14	70	16	62	54	70	76	82	94
20.75	16.60	12.45	**4.15**	22.75	18.20	13 65	**4.55**	24.75	19.80	14.85	**4.95**
80	64	48	16	80	24	68	56	80	84	88	96
85	68	51	17	85	28	71	57	85	88	91	97
90	72	54	18	90	32	74	58	90	92	94	98
95	76	57	19	95	36	77	59	95	96	97	99
21.00	16.80	12.60	**4.20**	23.00	18.40	13.80	**4.60**	25.00	20.00	15.00	**5.00**
05	84	63	21	05	44	83	61	05	04	03	01
10	88	66	22	10	48	86	62	10	08	06	02
15	92	69	23	15	52	89	63	15	12	09	03
20	96	72	24	20	56	92	64	20	16	12	04
21.25	17.00	12.75	**4.25**	23.25	18.60	13.95	**4.65**	25.25	20.20	15.15	**5.05**
30	04	78	26	30	64	98	66	30	24	18	06
35	08	81	27	35	68	14.01	67	35	28	21	07
40	12	84	28	40	72	04	68	40	32	24	08
45	16	87	29	45	76	07	69	45	36	27	09
21.50	17.20	12.90	**4.30**	23.50	18.80	14.10	**4.70**	25.50	20.40	15.30	**5.10**
55	24	93	31	55	84	13	71	55	44	33	11
60	28	96	32	60	88	16	72	60	48	36	12
65	32	99	33	65	92	19	73	65	52	39	13
70	36	13 02	34	70	96	22	74	70	56	42	14
21.75	17.40	13.05	**4.35**	23.75	19.00	14.25	**4.75**	25.75	20.60	15.45	**5.15**
80	44	08	36	80	04	28	76	80	64	48	16
85	48	11	37	85	08	31	77	85	68	51	17
90	52	14	38	90	12	34	78	90	72	54	18
95	56	17	39	95	16	37	79	95	76	57	19
22.00	17.60	13.20	**4.40**	24.00	19.20	14.40	**4.80**	26.00	20.80	15.60	**5.20**
05	64	23	41	05	24	43	81	05	84	63	21
10	68	26	42	10	28	46	82	10	88	66	22
15	72	29	43	15	32	49	83	15	92	69	23
20	76	32	44	20	36	52	84	20	96	72	24
22.25	17.80	13.35	**4.45**	24.25	19.40	14.55	**4.85**	26.25	21.00	15.75	**5.25**
30	84	38	46	30	44	58	86	30	04	78	26
35	88	41	47	35	48	61	87	35	08	81	27
40	92	44	48	40	52	64	88	40	12	84	28
45	96	47	49	45	56	67	89	45	16	87	29

SUGGESTIONS TO PATRONS OF CHEESE FACTORIES AND CREAMERIES. (CURTIS.)

Care of Milk.

1. All milk for the cheese factory must be clean, pure, and wholesome, or the cheese will be bad. One hundred pounds of bad milk will injure 10,000 pounds of good milk.

2. The law is very strict against watering or skimming. A fine of $10.00 to $100.00 is imposed if convicted.

3. After a cow has dropped her calf, the milk should not be taken to the factory until the tenth milking.

4. Milk run through an aerator as soon as drawn from the cow, in open air, is better for cheese and butter making than when set in a tub of water and dipped. By any means at your command thoroughly air the milk until cooled.

5. Stagnant water, dead carcasses, or filth of any kind in the pasture or barn-yard produces tainted milk. For this reason set the can of night's milk in a clean place.

6. Milk with clean hands; never wet them with milk; it is positively filthy.

7. See that the cow's udder is brushed clean and free from fine dirt and dust before milking.

8. Never mix the night's and morning's milk. It will many times sour them both by pouring the warm milk into the cold.

9. Small cans (10 to 15 gallons) are much preferred to larger ones, as the milk is kept in a better condition.

10. Whey should be taken home in separate cans from that in which the milk is brought in.

11. If whey is taken home in the milk-cans, empty at once, wash with tepid water, then scald and turn them out to the sun.

12. Insist that the cheese-maker keep the whey-vat clean, by washing and scalding at least twice a week.

13. Insist that your factory shall take in milk by the Babcock test, paying each patron according to what he delivers.

14. Use a Babcock test yourself and know just what you produce; turn off the poor cows and fill their places with

good ones. Every patron should know for himself whether he is boarding unprofitable cows. There is no better way of knowing this than by the use of the Babcock test at the barn. The cost of the test is but little, but its instruction is very valuable.

15. It should always be remembered that pure milk can only be had through healthy cows, pure feed, pure water, pure air, and cleanly handling. Every patron is affected in the cash outcome by the way his brother patrons produce and handle their milk, hence the necessity of each adhering to sound rules based on sound dairy sense. There is not a first-class factory in the land where good prices are obtained for cheese but what the patrons practise thorough cleanliness in the care of milk. Remember, it is a matter of profit to each to do this.

Care of Cows.

Pay special attention to the comfort of your cows. Do not let them remain out in cold rain-storms ; it will reduce the flow of milk. Feed liberally. The cow must at all times have all the good feed she can eat and digest. Be sure and provide some soiling-crop against the July and August drought; if the cow shrinks then you will lose money in the fall, when butter and cheese are high. Oats and peas, sweet corn or field corn, drilled 3½ feet apart, are a good soiling-crop.

A silo is a great help in the economical production of cow feed. Thousands of successful dairymen have proved this. It is no longer an experiment.

Dairy farming at high profit calls for close study concerning the cow, concerning her feed, and how to produce it at the best and cheapest. Every dairy neighborhood will show men who make nearly double the profit from the business that others do. We believe that it will pay every man to be intelligent and as well posted as he can be on these important questions. We must bring up the grade of our reputation by making better butter and cheese. This will bring on a larger and better paying demand. To cheat the

consumer with poor goods will, in the end, destroy the business. Better dairymen, better milk, better products, better reputation in the world's markets, will surely bring better profits, and is the only true road to DAIRY SUCCESS.

BY-LAWS AND RULES FOR CO-OPERATIVE CREAMERY ASSOCIATIONS.

I. This association shall be known as the — — Co-operative Creamery Association.

II. The purpose of the association shall be to locate, establish and carry on the manufacture and sale of milk products, in such a manner as will conduce to the greatest convenience and profit of the producers over the greatest amount of territory in the town of — — and vicinity. Also to purchase, use, and hold real and personal estate necessary for the transaction of the business of the association.

III. The capital stock of the association shall be — — dollars, divided into — — shares of ten dollars each.

IV. This association shall be co-operative. Cream and milk may be purchased or accepted from any person not a stockholder on the same terms and conditions as may be prescribed for stockholders.

V. Any person directly engaged in agricultural pursuits may become a member of this association by taking one or more shares of the stock of the association.

VI. 1. The regular meetings of the association shall be held semi-annually, viz., on the first Mondays in — — and — — — in each year, at such time and place as the board of directors may determine; and notice of such meeting shall be given by the clerk to each member by mail seven days at least previous to the date of said meeting. 2. Special meetings may be called either by the president, with the advice and consent of a majority of the directors, or upon written request of one third of the stockholders of the association, upon seven days' notice as above. 3. Meetings of the board of directors may be called by the president or by any two directors.

VII. 1. The officers of the association shall consist of a president, clerk, treasurer, five directors, and two auditors. 2. The president shall be chosen annually by the board of

directors, by written ballot, at the regular meeting in October. 3. The clerk, treasurer, board of directors, and auditors shall be chosen by the stockholders annually, by written ballot, at the regular meeting in October, and all officers shall hold office till others are chosen and qualified in their stead. Vacancies in the above-named offices may be filled at any meeting of the stockholders; in the meantime by the board of directors. In case of the absence of the clerk a temporary clerk may be chosen and qualified in his stead.

VIII. At any regularly called meeting of the association, nine of the members thereof, and at any meeting of the board of directors, three members thereof, shall constitute a quorum for the transaction of business. A less number may adjourn from time to time.

IX. It shall be the duty of the president, who shall be a director, to preside at all meetings of the association and of the board of directors, preserve order therein, put all questions, announce all decisions, and, in case of an equal division, to give the casting vote. He shall receive and safely preserve all bonds required of the officers of the association and sign all certificates or documents issued by the association or board of directors. In the absence of the president, it shall be the duty of one of the board of directors, in order of their seniority, to preside at any meeting.

X. It shall be the duty of the clerk to attend all meetings of the association and of the board of directors, and to keep a correct record of the same, which record shall be open for the inspection of any member. He shall give notice of all meetings and of all appointments on committees, to each member thereof, and to each officer chosen, of his election; and shall serve all such other notices as appertain to his office or as may be directed from time to time by the association or board of directors. He shall attest all certificates or documents issued signed by the president, shall file all bills and reports and such other documents as may be ordered to be filed, and shall carry on all such correspondence as may be directed; shall act as secretary of all committees when called upon; shall keep a correct

financial account between the association and its members, and shall have charge of all property not otherwise disposed of. He shall give such bonds for the faithful performance of his duty, and receive such compensation for his services, as the board of directors may determine.

XI. It shall be the duty of the treasurer to receive all money belonging to the association, giving his receipt therefor. He shall draw all money for the payment of claims against the association under the direction of the board of directors. He shall make a report to the board of directors at such times as they may require. He shall perform all duties required of him by the laws of the commonwealth and shall give such bonds for the faithful performance of his duty as the board of directors may require.

XII. It shall be the duty of the board of directors to attend to the general affairs of the association, invest the funds of the same, appoint such other agents and officers as in their judgment the interests of the association require, and fix all compensations. They shall keep or cause to be kept a correct account of all cream or milk furnished by the stockholders or patrons, and a correct account of all sales. They shall prescribe the rules and regulations governing the collection and delivery of the cream and milk; may cause the quality of the same to be tested as often as may be deemed expedient; may authorize the premises of any stockholder or patron to be inspected, and may reject and refuse to collect or receive any cream or milk that is unsatisfactory or not furnished in compliance with the prescribed regulations. They shall establish prices and have full power over the business of the association, and shall in all cases pursue such measures as in their judgment will tend to the best interests of the association. They shall make a full report of their doings, and a full statement of the business at each regular meeting, or whenever called upon to do so by vote of the stockholders.

XIII. The duties of the auditors shall be to audit all accounts of the association, making a report to the board of directors at the time of the regular meetings, and at such other times as they may require.

ever a request is presented to him signed by ten patrons. Whenever a meeting is to be called, the president shall give patrons at least two days' notice.

ART. 10. The action of the treasurer and salesman in regard to selling or holding cheese shall be governed by a vote of a majority of the patrons. If no vote is taken, he is to exercise his best judgment in the matter.

ART. 11. In voting at any annual or special meeting of this association the patrons shall be allowed one vote for every cow the milk of which is brought to the factory. [This may be altered to one vote on each share of the capital stock or one vote to each shareholder.]

ART. 12. The treasurer and salesman shall attend all meetings of the association whenever possible, and shall take minutes of the proceedings, and place the same on file in his office, and in other respects act as secretary. In case he should be absent, a temporary secretary may be chosen. In case the president is absent at any meeting, a temporary president may be chosen for a presiding officer.

RULES FOR PATRONS AND INSTRUCTIONS TO CREAM OR MILK GATHERERS.

These rules may be made to apply to either whole-milk or gathered cream creameries.

Feeding.—We insist upon only such food being fed to cows as will produce the largest and best quality of milk or cream. Turnips, onions, cabbage, or anything likely to injure the quality of milk, cream, or butter is prohibited.

Milking.—Cows must be carefully cleaned before milking, to avoid odors that taint the milk. The milk must be strained through two strainers—one of them cloth—before going into the cans. Thorough cleanliness must be observed in everything.

Creamers and Cans.—Creamers must be kept in a place free from odors, and cleanliness maintained in their vicinity. Tanks and cans must be kept sweet and clean, and the water free and clear. Cans must be *washed, then scalded every time* they are used. The water in the creamers should not go below 45 degrees in summer and 40 degrees in winter.

Setting Milk.—All cans must be filled full of fresh milk, so far as possible, and immediately placed in the tank. After cans are set in water they must not be disturbed. Patrons are not allowed to draw off the milk except on Sundays, or with permission from the trustees.

Mixing Milk.—Cans must not be partly filled at one milking and after standing long enough for the cream to begin to separate be filled with milk from another milking, or with anything whatever. After a can has once been set it must not in any way be disturbed or meddled with, nor the milk drawn off by the patrons, except on Sunday.

Night's Milk.—When milk is delivered but once each day, the cans containing the night's milk must be set in cold water immediately after milking and the milk thoroughly stirred by using a dipper and pouring until the milk is thoroughly cooled. A better plan is to use a cooler to thoroughly cool and aerate the milk before it is put in the cans. The night's milk must be left setting in cold water until it is hauled to the creamery.

Cream and Milk Gatherers.—Cream and milk gatherers are forbidden to take any cream or milk which is dirty, or for any reason, in their judgment, is not of satisfactory quality or condition, or which has been in any way so treated as to indicate that an attempt has been made to interfere with the proper and natural separation of the cream, or of its being correctly counted on the gauge, or in violation of these rules.

Any patron found neglecting or violating any of these rules must at once be reported to some one of the board of trustees or directors, and his cream or milk must not again be taken till he has satisfied the trustees that his neglect was, for good reasons, excusable; and if any patron shall more than once be so reported it shall be deemed a sufficient reason for refusal to again receive his cream at all.

Cream or milk gatherers are especially directed to take all possible pains to discover all violations or neglect of any of these rules, and strictly enforce them in every case.

These rules and instructions are found by experience and observation to be necessary for the protection of the association and the best good of all its members. Copies thereof will be securely posted conveniently near each tank where milk-cans are set, so that ignorance can be no excuse for neglect.

Patrons are requested to notify the board of trustees or directors if any cream or milk gatherer is in any way delinquent or careless in his observance of these instructions.

Patrons who are not disposed to be governed by these rules are requested to so advise the trustees or directors, and the treasurer will make prompt settlement with any who wish to withdraw.

By order of the trustees or directors.

.................................., President.

.................................., Treas.

PART III. GENERAL TOPICS.

I. CONSTITUTIONS OF AGRICULTURAL ASSOCIATIONS.

CONSTITUTION AND BY-LAWS OF AGRICULTURAL CLUBS.

Together With Rules of Order, and Order of Business.
(McKerrow.)

Constitution.

Preamble.—We, the undersigned, interested in agriculture and horticulture, and desirous to secure the benefits to be derived from organization, for the purpose of practical discussion and the promotion of the common interests of our pursuits, do subscribe the following Constitution:

Article I. *Name.*—This association shall be styled and known as the —— Agricultural Club.

Article II. *Objects.*—The objects of this club are to advance the knowledge and promote the general interests of agriculture and horticulture in this community.

Article III. *Officers.* — The officers shall consist of a president, vice-president, recording secretary, corresponding secretary, treasurer, and librarian.

Article IV. *Duties of Officers.*—Section 1. It shall be the duty of the president to preside at all meetings of the club; to enforce a due observance of the Constitution, By-laws, and Rules of Order; to assign topics of discussion at the suggestion of members. He shall neither make nor second any motion, but shall have the privilege of taking part in debate; and while he has the floor the meeting for the time being shall be in charge of the vice-president; but the president shall have no vote unless the club shall be equally divided.

Section 2. It shall be the duty of the vice-president to preside at all times when the president is absent, and while he shall have temporarily vacated the chair.

Section 3. The recording secretary shall keep a record of the proceedings of the club; also the name of each member, and shall on the regular last meeting of each year prepare and read the names of all members; and he shall have charge of the archives of the club.

Section 4. The corresponding secretary shall conduct the correspondence of the club and act as recording secretary in the absence of that officer. He shall also render such assistance to the recording secretary as that officer may require in the performance of his duties.

Section 5. The treasurer shall keep all money belonging to the club, and disburse the same under the direction of the club, according to its laws. He shall collect all fees and dues of members, and shall at some time during the month of December of each year notify such as are in arrears and request their dues. He shall keep a correct account of all moneys received and expended.

Section 6. The librarian shall have charge of the library and its appurtenances, regulating the use of the same by the members, according to the rules and regulations prescribed. He shall make a written report of the condition of the library at the annual meeting, and at such other times as the club may direct. He shall, within one week, deliver to his successor in office the library and its appurtenances, and all books, papers, and documents in his possession belonging to the club.

ARTICLE V. *Elections.*—All elections for officers shall be by ballot, and shall be held at the first regular meeting in January of each year; and their terms shall commence immediately after their election, to continue for one year, or until others are elected to fill their places. In the case of vacancy occurring in any office the club shall go immediately into an election to fill the same. A majority of all the votes cast shall be necessary to a choice.

ARTICLE VI. *Membership.*—Section 1. Any person interested in agriculture or horticulture, and of good moral standing, may become a member of this club by signing this Constitution, agreeing to support all laws and regulations made in pursuance thereof, and paying fifty cents annually into the treasury.

Section 2. Honorary membership may be conferred in

consideration of eminent character and services in honor of agriculture or horticulture and shall be conferred without fee or dues. The recipient shall not be entitled to hold office, but may take part in all discussions and vote on all questions.

ARTICLE VII. *Amendments.*—No alteration, amendment, or addition can be made to this Constitution, neither can any part of it be repealed, without a vote of two thirds of the members present. Any proposed alteration, amendment, addition, or repeal must be submitted in writing, filed with the recording secretary, and read at two regular meetings next preceding that on which the vote is taken.

By-laws.

ARTICLE I. This club shall assemble weekly (or twice a month) on —— evenings from November 1st to April 1st, and at such intervals thereafter as may be agreed upon by the club, or appointed by the president. The time and place of meeting may be altered at any regular meeting of the club by a vote of two thirds of all of the members present.

ARTICLE II. Section 1. Seven members shall constitute a quorum for the transaction of business of the club. A less number may meet, maintain a discussion on any topic, and adjourn to any given time.

Section 2. Persons present, not members of the club, may be invited to take part in all discussions of agricultural topics; but they shall take no part in the business of the club.

ARTICLE III. Section 1. If the funds of the club should at any time be exhausted, or inadequate to meet the demands contemplated by the Constitution, there shall be an equal assessment upon each member to make up the deficiency.

Section 2. No appropriation of money from the funds of the club shall be lawful, except in furtherance of the objects contemplated by the Constitution, as stated in article 2, or as especially provided by these By-laws.

ARTICLE IV. Section 1. There shall be a library estab-

lished for the use of the club in furtherance of the objects contemplated in article 2 of the Constitution.

Section 2. The library shall be open to the free use of the members of the club, who shall not be more than three months indebted to the treasury, subject to the prescribed rules and regulations.

Section 3. The library shall be maintained by the surplus fund, after defraying the expenses of the club, and by the voluntary contributions and donations of the members, to be duly accredited to each contributor and donor.

Section 4. The library shall be in charge of the librarian, as provided in article 4, section 6, of the Constitution. There shall be a standing library committee of three members appointed at each annual meeting, of whom the librarian shall be one, and *ex-officio* chairman, which shall have charge of the purchase and collection of books, papers, and pamphlets for the library, and perform such other duties as may be ordained.

Section 5. *Rules.*—Rule 1. No member shall have from the library more than one (two) book(s) at a time.

Rule 2. No volume shall be retained longer than two weeks, under penalty of a fine of ten cents for the first week of detention, and five cents for every week thereafter.

Rule 3. There shall be assessed for injuries as follows: 1st. For an injury beyond ordinary wear, an amount proportionate to the injury, ascertained by the librarian. 2d. For the loss of the volume, the cost of the book; and if one of a set, an amount sufficient to replace it, or purchase a new volume.

Rule 4. No person having incurred a fine shall be permitted to take books from the library until the fine is paid.

Article V. A vote of two thirds of all the members present shall be required to pass any appropriation of money by the club, other than for its necessary contingent expenses.

Article VI. Section 1. Any member who shall suffer his account with the treasurer to go unsettled for more than one year shall cease to be considered as belonging to the club, and his name shall be stricken from the roll accordingly.

Section 2. Any member who shall be guilty of any gross violation of the rules of order, or of profane or indecent language or conduct, at any of the meetings of the club shall be fined, reprimanded, or expelled, as the club may, by a two thirds vote, decide.

Section 3. Any member who shall become guilty of any heinous offence or disgraceful practice, such as to render him an unfit associate, shall, on conviction thereof, be expelled from the club.

ARTICLE VII. These By-laws may be amended in the same manner as the Constitution.

Standing Resolutions.

Resolved, That after this date the weekly meetings of this club shall be held on ——, at ——, or at the residences of the members of the club, at —— o'clock.

Resolved, That there shall be an Executive Committee, consisting of the president, recording secretary, and treasurer, having power to transact the necessary business of the club, during the term when the meetings are not held.

Rules of Order.

1. No question shall be stated unless moved by two members, nor open for discussion until stated by the president.

2. When a member intends to speak on a question, he shall rise in his place and respectfully address his remarks to the chair, confine his remarks to the question, and avoid personalities. Should more than one person rise at a time, the president shall determine who is entitled to the floor.

3. When a member is called to order by the president, or any other member he shall at once take his seat, and every point of order shall be decided by the president, without debate, subject to an appeal to the club.

4. In case of an appeal from the decision of the chair the question shall be put to the club thus: "Shall the decision of the chair be sustained?" which shall be decided without debate.

shall report the amount of money received during the year and the source from which it has been received; the amount of money expended during the year, and the objects for which it has been expended; the number of trees planted at the cost of the society, and the number planted by individuals; and, generally, all acts of the board that may be of interest to the society. This report shall be entered on the record of the society.

ART. 11. This constitution may be amended with the approval of two thirds of the members present at any annual meeting of the society, or at any special meeting called for that purpose, a month's notice of the proposed amendment, with its object, having been given.

CONSTITUTION OF ROAD LEAGUES.

ARTICLE 1. This organization shall be known as the ——— Road League of ——— County, ——— (State).

ART. 2. Its object shall be the improvement of public roads in ——— and vicinity.

ART. 3. Any person may become a member on payment of one dollar per annum, and shall be entitled to vote at annual meetings.

ART. 4. The annual meeting shall be held in November on Mondays on or preceding the full moon.

ART. 5. The business of the Road League shall be intrusted to a council of twelve, who shall be chosen by ballot at the annual meetings, and they shall hold office until their successors are elected.

By-laws.

ART. 1. The council of twelve shall convene as soon as possible after the election, and shall choose from their number a president, also a secretary and treasurer (who may be one and the same person), and the council shall hold meetings monthly at the call of the secretary.

ART. 2. The president shall preside at all meetings, and when absent a member present shall be called to the chair in the usual way.

ART. 3. The secretary shall keep a record of the proceedings of all meetings and conduct the correspondence of the league.

ART. 4. The treasurer shall keep an accurate account of receipts and disbursements in a book for that purpose, and all disbursements shall be authorized or approved by the council.

ART. 5. Meetings of the council may be called by order of the president, or at the request of three of its members, and five shall constitute a quorum.

ART. 6. The president shall appoint a monthly committee of two members of the council, who shall give special supervision to the work of the overseer in charge of the roads under the jurisdiction of the league, and serve until their successors are appointed.

ART. 7. The council shall fill all vacancies occurring by resignation or otherwise, and they may drop from their number any member who shall persistently neglect his duty, or manifest indifference by non-attendance of the monthly meetings.

ART. 8. The constitution and by-laws of this league may be changed by a two thirds vote of the entire council, notice of such change having been given in writing at a preceding meeting.

The *order of business* of the council shall be as follows. 1. Roll-call. 2. Reading of minutes of previous meeting. 3. Report of treasurer. 4. Unfinished business. 5. New business. 6. Reports of committees and of the overseers. 7. Adjournment.

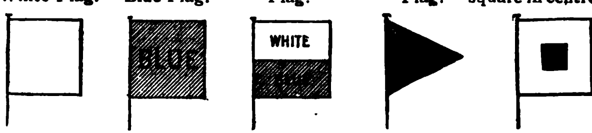
II. MISCELLANEOUS SUBJECTS AND TABLES.

EXPLANATION OF THE FLAG SIGNALS ADOPTED BY THE UNITED STATES WEATHER BUREAU.

The U. S. Weather Bureau furnishes, when practicable, for the benefit of the general public and those interests dependent to a greater or less extent upon weather conditions, the "Forecasts" which are prepared daily, at 10 A.M. and 10 P.M., for the following day. These weather forecasts are telegraphed to observers at stations of the Weather Bureau, railway officials, and many others, and are so worded as to be readily communicated to the public by means of flags or steam whistles. The flags adopted for this purpose are five in number, and of the form and dimensions indicated below:

Weather Flags.

No. 1. White Flag.	No. 2. Blue Flag.	No. 3. White and Blue Flag.	No 4. Black Triangular Flag.	No. 5. White Flag with black square in centre.



Clear or fair weather.	Rain or snow.	Local rains or snow	Temperature signal.	Cold wave.

Interpretation of Displays.

No. 1, alone: fair weather, stationary temperature.
No. 2, alone: rain or snow, stationary temperature.
No. 3, alone: local rain or snow, stationary temperature.
No. 1, with No. 4 above it: fair weather, warmer.
No. 1, with No. 4 below it: fair weather, colder.

No. 2, with No. 4 above it: warmer weather, rain or snow.

No. 2, with No. 4 below it: colder weather, rain or snow.

No. 3, with No. 4 above it: warmer weather, with local rains or snow.

No. 3, with No. 4 below it: colder weather, with local rains or snow.

Explanation of Whistle Signals.

A warning blast of from fifteen to twenty seconds' duration is sounded to attract attention. After this warning the longer blasts (of from four to six seconds' duration) refer to weather, and shorter blasts (of from one to three seconds' duration) refer to temperature; those for weather are sounded first.

Blasts.	Indicate.
One long	Fair weather
Two long	Rain or snow
Three long	Local rain or snow
One short	Lower temperature
Two short	Higher temperature
Three short	Cold wave

By repeating each combination a few times, with intervals of ten seconds, liability to error in reading the signals may be avoided.

Explanation of Storm and Hurricane Warnings.

Storm warning.—A red flag with a black center indicates that a storm of marked violence is expected.

The pennants displayed with the flags indicate the direction of the wind: red, easterly (from northeast to south); white, westerly (from southwest to north). The pennant above the flag indicates that the wind is expected to blow from the northerly quadrants; below, from the southerly quadrants.

By night a red light indicates easterly winds, and a white light above a red light, westerly winds.

Hurricane warning.—Two red flags with black centers, displayed one above the other, indicate the expected approach of a tropical hurricane, or one of those extremely severe and dangerous storms which occasionally move across the Lakes and northern Atlantic coast.

No night hurricane warnings are displayed.

LIST OF HEADQUARTERS OF STATE WEATHER SERVICES.

The headquarters of the state weather services are as follows:

Auburn, Alabama.
Little Rock, Arkansas.
Sacramento, California.
Denver, Colorado.
Atlanta, Georgia.
Springfield, Illinois.
Indianapolis or Lafayette, Indiana.
Des Moines, Iowa.
Topeka, Kansas.
Louisville, Kentucky.
New Orleans, Louisiana.
Baltimore, Maryland.
Cambridge, Massachusetts.
Lansing, Michigan.
Minneapolis, Minnesota.
University, Mississippi.
Columbia, Missouri.
Crete, Nebraska.
Carson City, Nevada.
New Brunswick, New Jersey.
Santa Fé, New Mexico.
Ithaca, New York.
Raleigh, North Carolina.
Bismarck, North Dakota.
Columbus, Ohio.
Portland or Oswego, Oregon.
Philadelphia, Pennsylvania.
Columbia, South Carolina.
Huron, South Dakota.
Nashville, Tennessee.
Galveston, Texas.
Lynchburg, Virginia.
Olympia, Washington.
Parkersburg, West Virginia.
Milwaukee, Wisconsin.

BENEFICIAL AND HARMFUL HAWKS AND OWLS.

(Yearbook U. S. Dept. of Agriculture.)

Much misapprehension exists among farmers as to the habits of birds of prey. Examination of the contents of the stomachs of such birds to the number of several thousand has established the fact that their food consists almost entirely of injurious mammals and insects, and that accordingly these birds are in most cases positively beneficial to the farmer, and should be fostered and protected.

Among those *wholly beneficial* are the large, rough-legged hawk; its near relative, the squirrel-hawk, or ferruginous roughleg; and the four kites: the white-tailed kite, Mississippi kite, swallow-tailed kite, and everglade kite.

The class that is *beneficial in the main*—that is, whose depredations are of little consequence in comparison with

the good it does—includes a majority of the hawks and owls, among them being the following species and their races: March hawk, Harris's hawk, red-tailed hawk, red-shouldered hawk, short-tailed hawk, white-tailed hawk, Swainson's hawk, short-winged hawk, broad-winged hawk, Mexican black hawk, Mexican goshawk, sparrow-hawk, Audubon's caraçara, barn-owl, long-eared owl, short-eared owl, great gray owl, barred owl, Western owl, Richardson's owl, Acadian owl, screech-owl, flammulated screech-owl, snowy owl, hawk-owl, burrowing owl, pygmy owl, ferruginous pygmy owl, and elf-owl.

The class in which *the harmful* and *the beneficial* qualities about balance each other includes the golden eagle, bald eagle, pigeon-hawk, Richardson's hawk, Aplomado falcon, prairie falcon, and the great horned owl.

The *harmful* class comprises the gyrfalcons, duck-hawk, sharp shinned hawk, Cooper's hawk, and goshawk.

HOW PATENTS ARE ISSUED.

Patents are issued in the name of the United States, and under the seal of the Patent Office, to any person who has invented or discovered any new and useful art, machine, manufacture, or composition of matter, or any new or useful improvement thereof, not known or used by others in this country, and not patented or described in any printed publication in this or any foreign country before the invention or discovery thereof, and not in public use or on sale for more than two years prior to his application, unless the same is proved to have been abandoned; and any person who by his own industry, genius, efforts, and expense has invented and produced any new and original design for a manufacture, bust, statua, alto-relievo or bas-relief, or any new and original design for the printing of woolen, silk, cotton, or other fabrics, any new and original impression, ornament, patent, pattern, print, or picture to be painted, printed, cast, or otherwise placed on or worked into any

article of manufacture ; or any new, useful, and original shape or configuration of any article of manufacture, the same not having been known or used by others before his invention or production thereof, or patented or described in any printed publication, may, upon payment of the fee prescribed and other due proceedings had, obtain a patent on the same.

Every patent contains a short title or description of the invention or discovery, correctly indicating its nature and design, and a grant to the patentee, his heirs or assigns, for the term of seventeen years of the exclusive right to make, use, and vend the invention or discovery throughout the United States and the Territories, referring to the specification for the particulars thereof.

If it appears that the inventor, at the time of making his application, believed himself to be the original and first inventor or discoverer, a patent will not be refused on account of the invention or discovery or any part thereof having been known or used in a foreign country before his invenvention or discovery thereof, if it had not been patented or described in a printed publication.

No person shall be debarred from receiving a patent for his invention by reason of its having been first patented in a foreign country, unless the application for the foreign patent was filed more than seven months prior to the filing of the application in this country. But every patent granted for an invention which has been previously patented in a foreign country shall be so limited as to expire at the same time with the foreign patent, or if there be more than one, at the same time with the one having the shortest term, but in no case shall it be in force more than seventeen years.

Joint inventors are entitled to a joint patent; neither can claim one separately. Independent inventors of distinct and independent improvements in the same machine cannot obtain a joint patent for their separate inventions; nor does the fact that one furnishes the capital and another makes the invention entitle them to make application as joint inventors ; but in such cases they may become joint patentees.

Applications.—Application for a patent must be made in writing to the Commissioner of Patents. The applicant must also file in the Patent Office a written description of the same, and of the manner and process of making, constructing, compounding and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art or science to which it appertains, or with which it is most nearly connected, to make, construct, compound, and use the same; and in case of a machine, he shall explain the principle thereof, and the best mode in which he has contemplated applying that principle, so as to distinguish it from other inventions; and particularly point out and distinctly claim the part, improvement, or combination which he claims as his invention or discovery. The specification and claim shall be signed by the inventor and attested by two witnesses.

When the nature of the case admits of drawings, the applicant must furnish a drawing of the required size, signed by the inventor or his attorney in fact, and attested by two witnesses, which shall be filed in the Patent Office. In cases of inventions that admit of representation by model, the applicant, if required by the Patent Office, shall furnish a model of convenient size to exhibit advantageously the several parts of the invention or discovery.

The applicant shall make oath that he does verily believe himself to be the original and first inventor and discoverer of the art, machine, manufacture, composition, or improvement for which he solicits a patent; that he does not know and does not believe that the same was ever before known or used, and shall state of what country he is a citizen and where he resides. Such oath may be made before any person within the United States authorized by law to administer oaths, or, when the applicant resides in a foreign country, before any minister, chargé d'affaires, consul, or commercial agent holding commission under the Government of the United States, or before any notary public of the foreign country in which the applicant may be, provided such notary is authorized by the laws of his country to administer oaths.

Mexico, North Carolina, South Carolina, Texas, and Virginia.

June 3, *Jefferson Davis' Birthday:* Florida.

July 4, *Independence Day:* All States and District of Columbia.

July 24, *Pioneers' Day:* Utah.

August 16, *Bennington Battle Day:* Vermont.

September, first Monday, *Labor Day:* All States and District of Columbia.

September 9, *Admission Day:* California.

October 15, *Lincoln Day:* Connecticut.

October 31, *Admission into the Union Anniversary:* Nevada.

November, *General Election Day* (first Tuesday after first Monday): Arizona, California, Colorado, Florida, Idaho, Indiana, Illinois, Maryland, Minnesota, Missouri, Montana, Nevada, New Hampshire, New Jersey, New York, North Dakota, Ohio, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Washington, West Virginia, Wisconsin, and Wyoming.

November, last Thursday, *Thanksgiving Day:* In all States, though not a stationary holiday in some.

December 25, *Christmas Day:* All States and District of Columbia.

Arbor Day is a legal holiday in Idaho, Kansas, Rhode Island, and Wyoming, the day being set by the governor.

Mardi Gras (the last day before Lent) is observed as a holiday in Alabama and Louisiana.

Good Friday is observed as a holiday in Alabama, Georgia, Louisiana, Maryland, Minnesota, Pennsylvania, and Tennessee.

Every Saturday after 12 *o'clock noon* is a legal holiday in New York, New Jersey, and New Orleans; also from June to September in Colorado and Pennsylvania.

WHAT TO DO IN CASE OF ACCIDENTS.

By J. Nobr, M.D., Stoughton, Wis.

To consider the cause, nature, effect, and treatment of the multiplicity of injuries due to accidents is impossible, except in a treatise devoted to the subject. The object here is to instruct the layman to use his reason and good sense to aid the afflicted till skilled help arrives. It is especially important that he refrains from doing a lot of foolish things, and does not give or apply remedies about which he knows nothing, the effects of which are often more dangerous to the patient than the injury itself.

The symptoms demanding urgent attention after an injury are usually shock, pain, bleeding, support, and adjustment of mangled or broken limbs, protection to open wounds, burned surfaces, bruises, etc.

Wounds.—The all-important item in the treatment of wounds or cuts is absolute cleanliness or asepsis. Asepsis can be secured by having everything that is to be used for the wound boiled just before applying it.

Before dressing a wound:

1st. Wash your hands, scrub and clean finger-nails thoroughly with soap and hot *boiled* water.

2d. Wash the limb or parts around cut or wound with *boiled* water and soap, being careful not to wash dirt from around the sore into it.

3d. Wash out the wound with *hot boiled* water. If there is still oozing from the cut surfaces,press clean cloths wrung out of *boiled* water as hot as hands can bear against the bleeding surfaces till it stops.

4th. Draw the edges of the wound together with strips of court-plaster.

5th. Lay over the wound so as to cover it well ten to twelve thicknesses of clean boiled and baked dry cheese-cloth, sheeting, or linen, and fasten on with a bandage.

6th. Let the injured parts be at rest. If you have secured asepsis and gotten the edges of the wound together closely, keep the wounded parts at rest for from three to six days; the wound will then heal *without* pain or pus, and without swelling, inflammation, or fever. Don't hinder

the healing of a wound by putting pitch, tobacco juice, "healing ointments," liniments, or other filth into it.

Broken or Mangled Limbs should be supported by temporary splints, made from boards, pasteboard, shingles, etc. Put one on each side of the limb and tie on with handkerchief or bandages. The splints should be long enough to support entire limb.

Burns and Scalds—If the burn is extensive, place the person in a bath of lukewarm water, keep the body immersed up to the chin, see that the water is kept warm; patient may be left in bath indefinitely. If the burn is not large, but painful, cover the burned surface with a thick layer of flour, powdered starch, zinc ointment, or cotton batting. Equal parts of limewater and linseed oil may be applied, and the burn covered with cotton. It is important in burns to apply a dressing that will exclude the air. In large burns there is always severe shock: treat this as directed below.

Shock.—When a person has been severely injured or badly frightened, there follows a condition of the nervous system which is known as shock. A person suffering from shock generally becomes pale, cold, faint, and trembling, with a small weak pulse. The mind is dull and the person looks anxious and distressed. Sometimes the person is excited and restless.

Treatment.—Let the person rest in a quiet cheerful place. If he is little injured, tell him so calmly. If the injury is severe, and there is pain, broken bones, bleeding, etc., you must still be calm, cheerful, and helpful. Give a tablespoonful (2 or 3, if a drinker) of whiskey in water every quarter or half hour. Wrap him in warm blankets and lay hot water bottles around him. If there is much pain, give 10 drops of laudanum. In case of bleeding, open wounds, or broken bones, treat them as directed. A flushed face and fever show that the patient is reviving and does not need hot-water bottles or whiskey. Never let an injured person be surrounded by a crowd of people.

Pain is frequently relieved by the adjustment and support of mangled limbs, by protecting exposed open wounds, burns, bruises, etc., with clean gauze dressings. Morphin ¼ grain, or 20 drops of laudanum, or 1 grain of opium can be given if pain

is unbearable. Unless absolutely necessary this treatment should be left to the physician.

Hemorrhage or Bleeding always occurs after an injury. It is the result of the tearing or cutting off of the blood-vessels. A person suffering from hemorrhage either internal or external is pale, faint, with feeble pulse.

Treatment.—Keep the person quiet. If the bleeding comes from a wound in the upper or lower limbs, it will stop by raising the limb up above the rest of the body. Tie clean cloths tightly over the sore. If the blood comes in spurts, tie a rope or handkerchief tightly around limb *above* cut nearest to body. If bleeding is slight, it will stop by tying clean cloths tightly over the cut. Ice may be applied over the bleeding vessels. Clean cloths wrung out of water as *hot* as hands can bear is often effective.

Never use cobwebs, tobacco juice, or other filthy things to stop bleeding. If a person spits or coughs up red frothy blood, he is probably bleeding from the lungs. Let him lie down, and if it continues to come up apply ice to chest and give a teaspoonful of extract of ergot.

Sunstroke and Heat Exhaustion.—In sunstroke the person has a red face; skin is hot and dry; there is high fever; breathing and pulse are very rapid. There is often delirium and convulsions. Put the patient in a cold bath; apply ice to the head and rub the skin with pieces of ice. If he cannot be put into a bath, put him in the shade and pour cold water over him, or wrap him in cold wet blankets and pour cold water over his head. In heat exhaustion the patient is pale and the skin cool. There is no fever. Let the person rest in the shade. Give stimulants, as hot coffee or whiskey.

Poisoning.—In any case of poisoning when the kind of poison is unknown, induce vomiting at once by giving warm water with or without a tablespoonful of ground mustard, or double this amount of salt to the teacup. Thrust your finger down his throat to help the emetic. Milk, raw eggs, gruel, oil should be given freely if irritant poisons, like potash, lye, or acids, have been taken. The following table contains suggestions for the proper treatment of the forms of poisoning occurring most frequently:

Poison.	Treatment.
Acids: Sulfuric, Nitric, Muriatic, Oxalic.	Give soap, soda, whitewash, or magnesia mixed in water. Produce vomiting. Give gruel, milk, eggs (uncooked). Relieve pain by giving 10 drops of laudanum in water.
Carbolic acid and creosote.	Give Epsom salts, raw eggs. Produce vomiting. Alcohol is the antidote. Give whisky, brandy, or alcohol freely if acid has been swallowed. Externally apply alcohol or cloths or cotton soaked in alcohol to the surface burned by the acid.
Alkalies: Ammonia, Soda, Potash, Lye.	Give vinegar, lemon or orange juice, or any acid diluted in plenty of water. Give milk, gruel, white of egg, oils. For pain give 10 drops of laudanum.
Arsenic, Paris green, Poison fly-paper, Rough on rats.	Produce vomiting if there is none already. Hydrated oxid of iron with magnesia in water is the antidote. Give 2 tablespoonsful of castor oil.
Corrosive sublimate.	Produce vomiting. Give a teaspoonful of tannin in water. Give raw eggs, milk, castor oil.
Iodin.	Produce vomiting. Give starch and water, raw eggs, milk, or gruel.
Opium, Morphin, Laudanum Paregoric,	Produce vomiting. Inject from a pint to a quart of strong coffee into rectum, or give by mouth if patient can swallow. Potassium permanganate is antidote. Keep patient awake.
Poison gas from coal stove.	Fresh air; stimulants, as coffee, ammonia.

The following additional suggestions are offered:

Lightning.—Dash cold water over person struck.

Mad-dog- or Snake-bite.—Tie cord tight above wound. Suck the wound and cauterize with caustic or white-hot iron at once, or cut out adjoining parts with a sharp knife. Give stimulants, as whisky, brandy, etc.

Sting of Venomous Insects, etc.—Apply weak ammonia, oil, salt water, or iodin.

Fainting.—Place flat on back, allow fresh air, and sprinkle with water. Place head lower than rest of body.

Cinders in the Eye.—Roll soft paper up like a lamp-lighter and wet the tip to remove cinder, or use a medicine-dropper to draw it out. Rub the *other* eye.

Fire in One's Clothing.—Don't run, especially not down-stairs or out-of-doors. Roll on carpet, or wrap in woolen rug or blanket. Keep the head down so as not to inhale flame.

Fire in a Building.—Crawl on the floor. The clearest air is the lowest in the room. Cover head with woolen wrap, wet if possible.

Fire from Kerosene.—Don't use water, it will spread the flames. Dirt, sand, or flour is the best extinguisher; or smother with woolen rug, table-cloth or carpet.

Suffocation from Inhaling Illuminating-gas.—Get into fresh air as soon as possible, and lie down. Keep warm. Take ammonia, 20 drops to a tumbler of water, at frequent intervals; also 2–4 drops tincture of nux vomica every hour or two for 5 or 6 hours. (*World Almanac*, 1899.)

INTEREST TABLES.

4%	$1	$2	$3	$4	$5	$6	$7	$8	$9	$10	$100	$1000
4 DAY.	0	0	0	0	0	0	0	0	0	0	5	45
8 "	0	0	0	0	0	0	0	0	1	1	9	89
12 "	0	0	0	0	0	1	1	1	1	2	13	1.34
16 "	0	0	0	0	1	1	1	2	2	2	18	1.78
20 "	0	0	0	1	1	2	2	2	2	2	22	2.22
24 "	0	0	1	1	2	2	2	2	3	3	27	2.67
28 "	0	0	1	1	2	2	2	3	3	3	31	3.11
1 MO..	0	0	1	2	2	2	3	3	3	3	33	3.34
2 "	0	2	2	3	4	4	5	6	6	7	67	6.67
3 "	1	2	3	4	5	6	7	8	9	10	1.00	10.00
6 "	2	4	6	8	10	12	14	16	18	20	2.00	20.00
1 YR...	4	8	12	16	20	24	28	32	36	40	4.00	40.00

5%	$1	$2	$3	$4	$5	$6	$7	$8	$9	$10	$100	$1000
4 DAY.	0	0	0	0	0	0	0	0	0	0	6	56
8 "	0	0	0	0	0	0	1	1	1	1	11	1.11
12 "	0	0	0	0	1	1	1	2	2	2	17	1.67
16 "	0	0	0	1	1	2	2	2	2	2	22	2.22
20 "	0	0	1	1	2	2	2	2	3	3	27	2.74
24 "	0	0	1	2	2	2	3	3	3	3	33	3.34
28 "	0	1	1	2	2	3	3	3	4	4	38	3.84
1 MO..	0	1	2	2	2	3	3	4	4	4	42	4.17
2 "	1	2	3	4	4	5	6	7	8	9	83	8.34
3 "	2	3	4	5	6	7	9	10	11	13	1.25	12.50
6 "	3	5	8	10	13	15	18	20	23	25	2.50	25.00
1 YR..	5	10	15	20	25	30	35	40	45	50	5.00	50.00

6%	$1	$2	$3	$4	$5	$6	$7	$8	$9	$10	$100	$1000
4 DAY.	0	0	0	0	0	0	0	1	1	1	7	67
8 "	0	0	0	1	1	1	1	1	1	1	13	1.33
12 "	0	0	1	1	1	1	1	2	2	2	20	2.00
16 "	0	1	1	1	1	2	2	2	2	3	27	2.67
20 "	1	1	1	2	2	2	2	3	3	3	33	3.33
24 "	1	1	1	2	2	2	3	3	4	4	40	4.00
1 MO..	1	1	2	2	3	3	4	4	5	5	50	5.00
2 "	1	2	3	4	5	6	7	8	9	10	1.00	10.00
3 "	2	3	5	6	8	9	11	12	14	15	1.50	15.00
6 "	3	6	9	12	15	18	21	24	27	30	3.00	30.00
1 YR...	6	12	18	24	30	36	42	48	54	60	6.00	60.00

7%	$1	$2	$3	$4	$5	$6	$7	$8	$9	$10	$100	$1000
4 DAY.	0	0	0	0	0	0	0	0	0	0	8	77
8 "	0	0	0	0	0	0	1	1	1	1	15	1.55
12 "	0	0	0	0	1	1	1	1	2	2	23	2.31
16 "	0	0	0	1	1	1	2	2	2	3	31	3.10
20 "	0	0	1	1	1	2	2	3	3	4	38	3.84
24 "	0	0	1	1	2	2	3	3	4	5	46	4.62
1 MO..	0	1	2	2	3	3	4	4	5	6	58	5.83
2 "	1	2	3	5	6	7	8	9	10	12	1.17	11.67
3 "	2	3	5	7	9	10	12	14	16	18	1.75	17.50
6 "	4	7	11	14	18	21	25	28	32	35	3.50	35.00
1 YR...	7	14	21	28	35	42	49	56	63	70	7.00	70.00

TABLE OF WAGES BY THE WEEK.

(Computed on a basis of ten hours' labor per day.)

Wages.	1 Hr.	2 Hrs.	5 Hrs.	8 Hrs.	9 Hrs.	1 Day.	2 Days.	3 Days.	4 Days.	5 Days.	6 Days.
$3	.05	.10	.25	.40	.45	.50	1.00	1.50	2.00	2.50	3.00
4	.06⅔	.13⅓	.33⅓	.53⅓	.60	.66⅔	1.33⅓	2.00	2.66⅔	3 33⅓	4.00
5	.08⅓	.16⅔	.41⅔	.66⅔	.75	.83⅓	1.66⅔	2.50	3.33⅓	4.16⅔	5.00
5	.10	.20	.50	.80	.90	1.00	2.00	3.00	4 00	5.00	6.00
7	.11⅔	.23⅓	.58⅓	.93⅓	1.05	1.16⅔	2.33⅓	3.50	4.66⅔	5.83⅓	7.00
8	.13⅓	.26⅔	.66⅔	1.06⅔	1.20	1.33⅓	2.66⅔	4.00	5.33⅓	6.66⅔	8.00
9	.15	.30	.75	1.20	1.35	1.50	3.00	4.50	6.00	7.50	9.00
10	.16⅔	.33⅓	.83⅓	1.33⅓	1.50	1.66⅔	3.33⅓	5.00	6 66⅔	8.33⅓	10.00
11	.18⅓	.36⅔	.91⅔	1.46⅔	1.65	1.83⅓	3.66⅔	5.50	7.33⅓	9.16⅔	11.00
12	.20	.40	1.00	1.60	1.80	2.00	4.00	6.00	8.00	10.00	12.00
13	.21⅔	.43⅓	1.08⅓	1.73⅓	1.95	2.16⅔	4 33⅓	6.50	8.66⅔	10.83⅓	13.00
14	.23⅓	.46⅔	1.16⅔	1.86⅔	2.10	2.33⅓	4.66⅔	7.00	9.33⅓	11.66⅔	14.00
15	.25	.50	1.25	2.00	2.25	2.50	5 00	7.50	10.00	12.50	15.00
16	.26⅔	.53⅓	1.33⅓	2.13⅓	2.40	2 66⅔	5.33⅓	8.00	10 66⅔	13.33⅓	16.00
17	.28⅓	.56⅔	1.41⅔	2.26⅔	2.55	2.83⅓	5.66⅔	8.50	11.33⅓	14.16⅔	17.00
18	.30	.60	1.50	2.40	2.70	3 00	6.00	9 00	12.00	15.00	18.00
19	.31⅔	.63⅓	1.58⅓	2 53⅓	2.85	3.16⅔	6.33⅓	9.50	12.66⅔	15.83⅓	19.00
20	.33⅓	.66⅔	1.66⅔	2.66⅔	3.00	3.33⅓	6.66⅔	10 00	13.33⅓	16.66⅔	20.00
24	.40	.80	2.00	3.20	3.60	4.00	8.00	12.00	16.00	20.00	24.00

TABLE OF WAGES BY THE DAY.

(Computed on a basis of ten hours' labor per day.)

	25c.	37½c.	50c.	62½c.	75c.	87½c.	$1.00	$1.12½	$1.25
½ hour..	.01¼	.01⅞	.02½	.03⅛	.03¾	.04⅜	.05	.05⅝	.06¼
1 "	.02½	.03¾	.05	.06¼	.07½	.08¾	.10	.11¼	.12½
2 "	.05	.07½	.10	.12½	.15	.17½	.20	.22½	.25
5 "	.12½	.18¾	.25	.31¼	.37½	.43¾	.50	.56¼	.62½
8 "	.20	.30	.40	.50	.60	.70	.80	.90	$1.00
9 "	.22½	.33¾	.45	.56¼	.67½	.78¾	.90	1.01¼	1.12½
1 day...	.25	.37½	.50	.62½	.75	.87½	$1.00	1.12½	1.25
2 days..	.50	.75	$1.00	$1.25	$1.50	$1.75	2.00	2.25	2.50
3 "	.75	$1.12½	1.50	1.87½	2.25	2.62½	3.00	3.37½	3.75
4 "	$1.00	1.50	2.00	2.50	3 00	3.50	4.00	4 50	5.00
5 "	1.25	1.87½	2.50	3 12½	3.75	4.37½	5.00	5.62½	6.25
6 "	1.50	2.25	3.00	3.75	4.50	5.25	6.00	6.75	7.50

	$1.37½	$1.50	$1.62½	$1.75	$1.87½	$2.00	$2.12½	$2.25	$2.37½
½ hour..	.06⅞	.07½	.08⅛	.08¾	.09⅜	.10	.10⅝	.11¼	.11⅞
1 "	.13¾	.15	.16¼	.17½	.18¾	.20	.21¼	.22½	.23¾
2 "	.27½	.30	.32½	.35	.37½	.40	.42½	.45	.47½
5 "	.68¾	.75	.81¼	.87½	.93¾	$1.00	$1.06¼	$1.12½	$1.18¾
8 "	$1.10	$1.20	$1.30	$1.40	$1.50	1.60	1.70	1.80	1.90
9 "	1.23¾	1.35	1.46¼	1.57½	1.68¾	1.80	1.91¼	2.02½	2.13¾
1 day...	1.37½	1.50	1.62½	1.75	1.87½	2.00	2.12½	2.25	2.37½
2 days..	2.75	3.00	3.25	3.50	3 75	4 00	4.25	4.50	4.75
3 "	4.12½	4.50	4.87½	5.25	5.62½	6.00	6.37½	6.75	7.12½
4 "	5.50	6.00	6.50	7.00	7.50	8 00	8.50	9.00	9.50
5 "	6.87½	7.50	8.12½	8.75	9 37½	10.00	10.62½	11.25	11.87½
6 "	8.25	9.00	9.75	10.50	11.25	12 00	12.75	13.50	14.25

NUMBER OF DAYS BETWEEN DATES WITHIN TWO YEARS.

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	
1	1	32	60	91	121	152	182	213	244	274	305	335	366	397	425	456	486	517	547	578	609	639	670	700	1
2	2	33	61	92	122	153	183	214	245	275	306	336	367	398	426	457	487	518	548	579	610	640	671	701	2
3	3	34	62	93	123	154	184	215	246	276	307	337	368	399	427	458	488	519	540	580	611	641	672	702	3
4	4	35	63	94	124	155	185	216	247	277	308	338	369	400	428	459	489	520	550	581	612	642	673	703	4
5	5	36	64	95	125	156	186	217	248	278	309	339	370	401	429	460	490	521	551	582	613	643	674	704	5
6	6	37	65	96	126	157	187	218	249	279	310	340	371	402	430	461	491	522	552	583	614	644	675	705	6
7	7	38	66	97	127	158	188	219	250	280	311	341	372	403	431	462	492	523	553	584	615	645	676	706	7
8	8	39	67	98	128	159	189	220	251	281	312	342	373	404	432	463	493	524	554	585	616	646	677	707	8
9	9	40	68	99	129	160	190	221	252	282	313	343	374	405	433	464	494	525	555	586	617	647	678	708	9
10	10	41	69	100	130	161	191	222	253	283	314	344	375	406	434	465	495	526	556	587	618	648	679	709	10
11	11	42	70	101	131	162	192	223	254	284	315	345	376	407	435	466	496	527	557	588	619	649	680	710	11
12	12	43	71	102	132	163	193	224	255	285	316	346	377	408	436	467	497	528	558	589	620	650	681	711	12
13	13	44	72	103	133	164	194	225	256	286	317	347	378	409	437	468	498	529	559	590	621	651	682	712	13
14	14	45	73	104	134	165	195	226	257	287	318	348	379	410	438	469	499	530	560	591	622	652	683	713	14
15	15	46	74	105	135	166	196	227	258	288	319	349	380	411	439	470	500	531	561	592	623	653	684	714	15
16	16	47	75	106	136	167	197	228	259	289	320	350	381	412	440	471	501	532	562	593	624	654	685	715	16
17	17	48	76	107	137	168	198	229	260	290	321	351	382	413	441	472	502	533	563	594	625	655	686	716	17
18	18	49	77	108	138	169	199	230	261	291	322	352	383	414	442	473	503	534	564	595	626	656	687	717	18
19	19	50	78	109	139	170	200	231	262	292	323	353	384	415	443	474	504	535	565	596	627	657	688	718	19
20	20	51	79	110	140	171	201	232	263	293	324	354	385	416	444	475	505	536	566	597	628	658	689	719	20
21	21	52	80	111	141	172	202	233	264	294	325	355	386	417	445	476	506	537	567	598	629	659	690	720	21
22	22	53	81	112	142	173	203	234	265	295	326	356	387	418	446	477	507	538	568	599	630	660	691	721	22
23	23	54	82	113	143	174	204	235	266	296	327	357	388	419	447	478	508	539	569	600	631	661	692	722	23
24	24	55	83	114	144	175	205	236	267	297	328	358	389	420	448	479	509	540	570	601	632	662	693	723	24
25	25	56	84	115	145	176	206	237	268	298	329	359	390	421	449	480	510	541	571	602	633	663	694	724	25
26	26	57	85	116	146	177	207	238	269	299	330	360	391	422	450	481	511	542	572	603	634	664	695	725	26
27	27	58	86	117	147	178	208	239	270	300	331	361	392	423	451	482	512	543	573	604	635	665	696	726	27
28	28	59	87	118	148	179	209	240	271	301	332	362	393	424	452	483	513	544	574	605	636	666	697	727	28
29	29		88	119	149	180	210	241	272	302	333	363	394		453	484	514	545	575	606	637	667	698	728	29
30	30		89	120	150	181	211	242	273	303	334	364	395		454	485	515	546	576	607	638	668	699	729	30
31	31		90		151		212	243		304		365	396		455		516		577	608		669		730	31

Applies to ordinary years only. For leap-years add 1 day to each number of days after February 28.

DOMESTIC POSTAGE.

First-class. Letters and other matter, wholly or partly in writing, and matter sealed or otherwise closed against inspection, 2 cents for each ounce or fraction thereof.

Post cards, and postal cards, 1 cent each.

"Drop letters," 1 cent for each ounce or fraction thereof when mailed at post-offices where letter carrier service is not established and at offices where the patrons can not be served by rural or star route carriers.

A "drop letter" is one addressed for delivery at the office where mailed. Letters deposited in boxes along a rural or star route are subject to postage at the rate of 2 cents an ounce or fraction thereof. There is no drop rate on mail other than letters.

Second-class—Unsealed. Newspapers and periodical publications of the second class, when sent by others than the publisher or a news agent, 1 cent for each four ounces or fraction thereof, on each separately addressed copy or package of unaddressed copies, to be prepaid by stamps affixed.

To be entitled to the rate of 1 cent for four ounces, copies of newspapers or periodical publications must be complete. Partial or incomplete copies are third-class matter.

Third-class—Unsealed. Printed matter, 1 cent for each two ounces or fraction thereof, on each individually addressed piece or parcel.

Fourth-class—Unsealed. Merchandise, 1 cent for each ounce or fraction thereof, on each individually addressed piece or parcel, except seeds, bulbs, roots, scions, and plants, on which the rate is 1 cent for each two ounces or fraction thereof.

Concealed Matter. Matter of a higher class enclosed with matter of a lower class subjects the whole package to the higher rate.

For knowingly concealing or enclosing any matter of a higher class in that of a lower class, and depositing or causing the same to be deposited in the mails, at a less rate than would be charged for such higher-class matter, the offender is liable to a fine of not more than one hundred dollars.

FOREIGN POSTAGE.

The rates of postage applicable to articles for foreign countries are as follows:

	Cents.
Letters for England, Ireland, Newfoundland, Scotland and Wales per ounce	2
Letters for Germany by direct steamers, per ounce	2
Letters for all other foreign countries, and for Germany when not dispatched by direct steamers:	
For the first ounce or fraction of an ounce	5
For each additional ounce or fraction of an ounce	3
Single postcards (including souvenir cards), each	2
Reply post cards, each	4
Printed matter of all kinds, for each two ounces or fraction of two ounces	1
Commercial papers, for the first ten ounces or less	5
For each additional two ounces or fraction of two ounces	1
Samples of merchandise, for the first four ounces or less	2
For each additional two ounces or fraction of two ounces	1
Registration fee in addition to postage	10

PARCEL POST, FOR U. S. AND POSSESSIONS.

Weight limit, 50 pounds (first and second zones), 20 pounds (other zones). Size, length and girth combined, 72 inches. 4 ozs. or less, 1 cent an ounce, regardless of distance. Over 4 ozs. at following rates, a fraction of a pound being considered a full pound.

Zone.	Distances.	First Pound.	Each Additional Pound.
Local	(within P. O. District)	5 cents	1 cent
First	within 50 miles	5 "	1 "
Second	50–100 miles	5 "	1 "
Third	150–300 "	6 "	2 "
Fourth	300–600 "	7 "	4 "
Fifth	600–1000 "	8 "	6 "
Sixth	1000–1400 "	9 "	8 "
Seventh	1400–1800 "	11 "	10 "
Eighth	Over 1800 "	12 "	12 "

Address of sender, preceded by the word "From," required. Insurance against loss not to exceed $25, 5 cents extra; and not to exceed $50, 10 cents extra.

Money Order Fees.—For Money Orders in denominations of $100 or less, the following fees are charged: Orders not exceeding $2.50, 3c.; over $2.50 to $5, 5c.; $5 to $10, 8c.; $10 to $20, 10c.; $20 to $30, 12c.; $30 to $40, 15c.; $40 to $50, 18c.; $50 to $60, 20c.; $60 to $75, 25c.; $75 to $100, 30c.

INTERNATIONAL OR FOREIGN MONEY-ORDER FEES.

For orders of $10, or less 10c.	Over $50, not exceeding $60, 60c.
Over $10, not exceeding $20, 20c.	Over $60, not exceeding $70, 70c.
Over $20, not exceeding $30, 30c.	Over $70, not exceeding $80, 80c.
Over $30, not exceeding $40, 40c.	Over $80, not exceeding $90, 90c.
Over $40, not exceeding $50, 50c.	Over $90, not exceeding $100, $1.

Express Money Orders may be bought of the leading express companies at the following rates: Not over $2.50, 3c.; $2.50 to $5, 5c.; $5 to $10, 8c.; $10 to $20, 10c.; $20 to $30, 12c.; $30 to $40, 15c.; $40 to $50, 18c.; $50 to $60, 20c.; $60 to $75, 25c.; $75 to $100, 30c.; over $100 at above rates.

III. WEIGHTS AND MEASURES.

CUSTOMARY SYSTEM OF WEIGHTS AND MEASURES.

I. Weights.

A. AVOIRDUPOIS WEIGHT.

1 ton = 2000 pounds (lbs.);*

1 lb. = 16 ounces (oz.) = 256 drams = 768 scruples = 7680 grains;
1 oz. = 16 drams = 48 scruples = 480 grains;
1 dram = 3 scruples = 30 grains;
1 scruple = 10 grains.

B. APOTHECARIES' WEIGHT, FOR DRUGS.

1 lb. = 12 oz. = 96 drams = 288 scruples = 5760 grains;
1 oz. = 8 drams = 24 scruples = 480 grains;
1 dram = 3 scruples = 60 grains;
1 scruple = 20 grains.

C. TROY WEIGHT, FOR JEWELS AND PRECIOUS METALS.

1 lb. = 12 oz. = 24 carats = 240 pennyweight (dwt.) = 5760 grains;
1 oz. = 2 carats = 20 dwts. = 480 grains;
1 carat = 10 dwts. = 240 grains;
1 dwt. = 24 grains.

II. Measures.

A. LINEAR.

1 mile = 8 furlongs (frlgs.) = 80 chains = 320 rods = 5280 feet;†
1 furlong = 10 chains = 40 rods = 660 feet;
1 chain = 4 rods = 66 feet;
1 rod = 16½ feet;
1 chain = 100 links;
1 link = 7.92 inches;

1 yard = 3 feet = 36 inches;
1 foot = 12 inches.

B. SURFACE.

1 square mile = 640 acres;
1 acre = 10 square chains = 160 sq. rods = 4840 sq. yds.
= 43,560 square feet.

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* 1 long ton = 20 imperial hundredweights (cwt.) = 2240 pounds.

† 1 sea mile (Admiralty knot) = 6080 feet, or 1.1515 statute mile.

C. CAPACITY.

1. DRY MEASURE.

1 bushel = the volume of 77.627 lbs. of distilled water at 4°C.;
1 bushel = 4 pecks = 8 gallons = 32 quarts = 2150.4 cubic inches;
1 peck = 2 gallons = 8 quarts = 537.6 " "
1 gallon = 4 quarts = 268.8 " "
1 quart = 67.2 " "

2. LIQUID MEASURE.

1 gallon = the volume of 8.3388822 lbs. = 58,373 troy grains of distilled water at 4° C.;*
1 gallon = 4 quarts = 8 pints = 32 gills = 231 cubic inches;
1 quart = 2 pints = 8 gills = 57.75 " "
1 pint = 4 gills = 28.88 " "

Metric System of Weights and Measures.

1. LINEAR MEASURES.

1 meter (m) = 10 decimeters (dm) = 100 centimeters (cm) = 1000 millimeters (mm) = .1 decameters (Dm) = .01 Hectometer (Hm) = .001 Kilometer (Km) = .0001 Myriameter (Mm).

1 Mm = 10 Km = 100 Hm = 1000 Dm = 10,000 m;
1 Km = 10 Hm = 100 Dm = 1,000 m;
1 Hm = 10 Dm = 100 m;
1 Dm = 10 m;

1 m = 10 dm = 100 cm = 1000 mm;
1 dm = 10 cm = 100 mm;
1 cm = 10 mm.

2. SURFACE MEASURES.

1 Are (a) = 100 square meters (sq. m.) = .01 hectare (ha);
1 Are = 1 sq. Dm. = 100 square m;
1 sq. Km = 100 Ha = 10,000 A = 1,000,000 sq. m;
1 Ha = 100 A = 10,000 sq. m;
1 A = 100 sq. m.

3. MEASURES OF CAPACITY.

1 liter (l) = 1 cubic decimeter (cdm) = 1,000 cubic centimeters (c. c.) = 0.001 cubic meter (cbm) = 10 deciliters (dl) = 100 centiliters (cl) = .01 hectoliter (hl).

1 Hl = 10 Dl = 100 l = 1,000 dl = 10,000 cl;
1 Dl = 10 l = 100 dl = 1,000 cl;
1 l = 10 dl = 100 cl.

4. WEIGHTS.

1 kilogram (kg) = 100 decagrams (Dg) = 1000 grams (g);
1 gram = 10 decigrams (dg) = 100 centigrams (cg) = 1,000 milligrams (mg);
1 ton = 1000 Kg = 100,000 Dg = 1,000,000 g;
100 Kg = 10,000 Dg = 100,000 g;
1 Kg = 100 Dg = 1,000 g.

* 1 Imperial gallon = 277.274 cub. inches, or .16046 cub. foot; it equals 1.20032, or very nearly 1⅕ U. S. liquid gallons. 1 cub. foot = 1728 cub. inches = 7.48 U. S. liquid gallons = 6.43 U. S. dry gallons = 6.23 Imperial

Conversion of U. S. Weights and Measures to Metric, and vice versa.

LINEAR.

	Inches to Millimeters.	Feet to Meters.	Yards to Meters.	Miles to Kilometers.
1 =	25.4001	.3048	.9144	1.6094
	Meter to Inches.	Meter to Feet.	Meter to Yards.	Kilometer to Miles.
1 =	39.3700	3.2808	1.0936	.6214

SQUARE.

	Sq. Inches to Sq. Centmr.	Sq. Feet to Sq. Decimeters.	Square Yards to Square Meters.	Acres to Hectares.
=	6.452	9.290	.836	.4047
	Sq. Centime. to sq. in.	Sq. Meters to Sq. Feet.	Square Meters to Square Yards.	Hectares to Acres.
=	.1550	10.764	1.196	2.471

CUBIC.

	Cubic In. to Cu. Centmr.	Cubic Feet to Cubic Meters.	Cubic Yards to Cubic Meters.	Bushels to Hectoliters.
=	16 387	.0283	.765	.3524
	Cu. Centmrs to Cubic In.	Cu. Decimeters to Cubic Inches.	Cubic Meters to Cubic Feet.	Cubic Meters to Cubic Yards.
1 =	.0610	61.023	35.314	1.308

CAPACITY.

	Fluid Drams to Cu. Centimeters.	Fluid Ounces to Cubic Centimeter.	Quarts to Liters.	Gallons to Liters.	
1 =	3.70	29.57	.9464	3.7854	
	Cu. Centimeters to Fluid Drams.	Centiliters to Fluid Ounces.	Liters to Quarts.	Decaliters to Gallons.	Hectoliters to Bushels.
1 =	.27	.338	1.0567	2.6417	2.8377

WEIGHT.

	Grains to Milligrams.	Avoirdupois Ounces to Grams.	Avoirdupois Pounds to Kilo-Grams.	Troy Ounces to Grams.
1 =	64.7989	28.3495	.4536	31.1035
	Milligrams to Grains.	Kilograms to Grains.	Hectograms to Ounces Av.	Kilograms to Pounds Av.
1 =	.01543	15432.36	3.5274	2.2046
	Quintals to Pounds Av.	Milliers or Tonnes to Pounds Av.		Kilograms to Ounces Troy.
=	220.46	2204.6		32.1507

KILOGRAMS CONVERTED INTO POUNDS AVOIRDUPOIS.

Kilos.	0	1	2	3	4	5	6	7	8	9
0.0	.000	.022	.044	.066	.088	.110	.132	.154	.176	.194
.1	.220	.243	.265	.287	.309	.331	.353	.375	.397	.419
.2	.441	.463	.485	.507	.529	.551	.573	.595	.617	.639
.3	.661	.683	.705	.728	.750	.772	.794	.816	.838	.860
.4	.882	.904	.926	.948	.970	.992	1.014	1.036	1.058	1.080
.5	1.102	1.124	1.146	1.168	1.190	1.213	1.235	1.257	1.279	1.301
.6	1.323	1.345	1.367	1.389	1.411	1.433	1.455	1.477	1.499	1.521
.7	1.543	1.565	1.587	1.609	1.631	1.653	1.676	1.698	1.720	1.742
.8	1.764	1.786	1.808	1.830	1.852	1.874	1.896	1.918	1.940	1.962
.9	1.984	2.006	2.028	2.050	2.072	2.094	2.116	2.138	2.161	2.183

POUNDS CONVERTED INTO KILOGRAMS.

Pounds.	0	1	2	3	4	5	6	7	8	9
0.0	.000	.005	.009	.014	.018	.023	.027	.032	.036	.041
.1	.045	.050	.054	.059	.064	.068	.073	.077	.082	.086
.2	.091	.095	.100	.104	.109	.113	.118	.122	.127	132
.3	.136	.141	.145	.150	.154	.159	.163	.168	.172	.177
.4	.181	.186	.191	.195	.200	.204	.209	.213	.218	.222
.5	.227	.231	.236	.240	.245	.249	.254	.259	.263	.268
.6	.272	.277	.281	.286	.290	.295	.299	.304	.308	.313
.7	.318	.322	.327	.331	.336	.340	.345	.349	.354	.358
.8	.363	.367	.371	.376	.381	.386	.390	.395	.399	.404
.9	.408	.413	.417	.422	.426	.431	.435	.440	.445	.449

INCHES REDUCED TO DECIMALS OF A FOOT.

(TRAUTWINE.)

Ins.	Foot.	Ins.	Foot.	Ins.	Foot.	Ins.	Foot.	Ins.	Foot.
1/32	.0026	1	.0833	2	.1667	6	.5000	10	.8333
1/16	.0052	1 1/8	.0938	2 1/2	.2083	6 1/2	.5417	10 1/2	.8750
1/8	.0104	1 1/4	.1042	3	.2500	7	.5833	11	.9167
1/4	.0208	1 3/8	.1146	3 1/2	.2917	7 1/2	.6250	11 1/2	.9583
3/8	.0313	1 1/2	.1250	4	.3333	8	.6667	12	1.0000
1/2	.0417	1 5/8	.1354	4 1/2	.3750	8 1/2	.7083		
5/8	.0521	1 3/4	.1458	5	.4167	9	.7500		
3/4	.0625	1 7/8	.1563	5 1/2	.4583	9 1/2	.7917		
7/8	.0729								

OUNCES REDUCED TO DECIMALS OF A POUND.

1 oz. = .06 lb.	9 oz. = .56 lb.
2 " = .13 "	10 " = .63 "
3 " = .19 "	11 " = .69 "
4 " = .25 "	12 " = .75 "
5 " = .31 "	13 " = .81 "
6 " = .38 "	14 " = .88 "
7 " = .43 "	15 " = .94 "
8 " = .50 "	16 " = 1 "

WEIGHT AND MEASURE CONVERSION TABLE.

Units.	Inches to Millimeters.	Millimeters to Inches.	Feet to Meters.	Meters to Feet.	Miles to Kilometers.	Kilometers to Miles.	Miles to Knots.	Knots to Stat. Miles.
1	25.4	.0394	.305	3.28	1.609	.621	.868	1.153
2	50.8	.0787	.610	6.56	3.219	1.243	1.735	2.306
3	76.2	.1181	.914	9.84	4.828	1.864	2.603	3.458
4	101.6	.1575	1.219	13.12	6.437	2.486	3.470	4.611
5	127.0	.1969	1.524	16.40	8.047	3.107	4.338	5.764
6	152.4	.2362	1.829	19.69	9.656	3.728	5.205	6.917
7	177.8	.2756	2.134	22.97	11.265	4.350	6.073	8.070
8	203.2	.3150	2.438	26.25	12.875	4.971	6.940	9.222
9	228.6	.3543	2.743	29.53	14.484	5.593	7.808	10.375

	Sq. Feet to Sq. Meters.	Sq. Meters to Sq. Feet.	Acres to Hectares.	Hectares to Acres.	Cub. Feet to Cub. Meters.	Cub. Meters to Cub. Feet.	Bushels to Hectoliters.	Hectoliters to Bushels.
1	.0929	10.76	.405	2.47	.028	35.3	.35	2.84
2	.1858	21.53	.809	4.94	.057	70.6	.70	5.68
3	.2787	32.29	1.214	7.41	.085	105.9	1.06	8.51
4	.3716	43.06	1.619	9.88	.113	141.3	1.41	11.35
5	.4645	53.82	2.024	12.36	.142	176.6	1.76	14.19
6	.5574	64.58	2.428	14.83	.170	211.9	2.11	17.03
7	.6503	75.35	2.833	17.30	.198	247.2	2.47	19.86
8	.7432	86.11	3.238	19.77	.226	282.5	2.82	22.70
9	.8361	96.88	3.642	22.24	.255	317.8	3.17	25.54

	Fluid Oz. to C.c.	C.c. to Fluid Oz.	Quarts to Liters.	Liters to Quarts.	Gallons to Liters.	Liters to Gallons.	Ounces to Grams.	Ounces to Pounds.
1	29.6	.338	.95	1.06	3.79	.26	28.3	.063
2	59.1	.676	1.89	2.11	7.57	.53	56.7	.125
3	88.7	1.014	2.84	3.17	11.36	.79	85.1	.188
4	118.3	1.352	3.79	4.23	15.14	1.06	113.4	.250
5	147.9	1.690	4.73	5.28	18.92	1.32	141.8	.313
6	177.4	2.028	5.68	6.34	22.71	1.59	170.1	.375
7	207.0	2.366	6.62	7.40	26.50	1.85	198.5	.438
8	236.6	2.704	7.57	8.45	30.28	2.11	226.8	.500
9	266.1	3.042	8.52	9.51	34.07	2.38	255.1	.563

TABLE OF RECIPROCALS OF NUMBERS.

The reciprocal of a number is the quantity obtained by dividing one by that number.

No.	Reciprocal.	No.	Reciprocal.	No.	Reciprocal.	No.	Reciprocal.
1	1.00000	26	.03846	51	.01961	76	.01316
2	0.50000	27	.03704	52	.01923	77	.01299
3	.33333	28	.03571	53	.01887	78	.01282
4	.25000	29	.03448	54	.01852	79	.01266
5	.20000	30	.03333	55	.01818	80	.01250
6	.16667	31	.03226	56	.01786	81	.01235
7	.14286	32	.03125	57	.01754	82	.01220
8	.12500	33	.03030	58	.01724	83	.01205
9	.11111	34	.02941	59	.01695	84	.01190
10	.10000	35	.02857	60	.01667	85	.01176
11	.09091	36	.02778	61	.01639	86	.01163
12	.08333	37	.02703	62	.01613	87	.01149
13	.07692	38	.02632	63	.01587	88	.01136
14	.07143	39	.02564	64	.01563	89	.01124
15	.06667	40	.02500	65	.01538	90	.01111
16	.06250	41	.02439	66	.01515	91	.01099
17	.05882	42	.02381	67	.01493	92	.01087
18	.05556	43	.02326	68	.01471	93	.01075
19	.05263	44	.02273	69	.01449	94	.01064
20	.05000	45	.02222	70	.01429	95	.01053
21	.04762	46	.02174	71	.01408	96	.01042
22	.04545	47	.02128	72	.01389	97	.01031
23	.04348	48	.02083	73	.01370	98	.01020
24	.04167	49	.02041	74	.01351	99	.01010
25	.04000	50	.02000	75	.01333	100	.01000

COMPARISONS OF FAHRENHEIT, CENTIGRADE (CELSIUS), AND REAUMUR THERMOMETER SCALES.

Fahrenheit.	Centigrade.	Réaumur.	Fahrenheit.	Centigrade.	Réaumur.
+212	+100	+80	+158	+70	+56
211	99.44	79.56	157	69.44	55.56
210	98.89	79.11	156	68.89	55.11
209	98.33	78.67	155	68.33	54.67
208	97.78	78.22	154	67.78	54.22
207	97.22	77.78	153	67.22	53.78
206	96.67	77.33	152	66.67	53.33
205	96.11	76.89	151	66.11	52.89
204	95.55	76.44	150	65.55	52.44
203	95	76	149	65	52
202	94.44	75.56	148	64.44	51.56
201	93.89	75.11	147	63.89	51.11
200	93.33	74.67	146	63.33	50.67
199	92.78	74.22	145	62.78	50.22
198	92.22	73.78	144	62.22	49.78
197	91.67	73.33	143	61.67	49.33
196	91.11	72.89	142	61.11	48.89
195	90.55	72.44	141	60.55	48.44
194	90	72	140	60	48
193	89.44	71.56	139	59.44	47.56
192	88.89	71.11	138	58.89	47.11
191	88.33	70.67	137	58.33	46.67
190	87.78	70.22	136	57.78	46.22
189	87.22	69.78	135	57.22	45.78
188	86.67	69.33	134	56.67	45.33
187	86.11	68.89	133	56.11	44.89
186	85.55	68.44	132	55.55	44.44
185	85	68	131	55	44
184	84.44	67.56	130	54.44	43.56
183	83.89	67.11	129	53.89	43.11
182	83.33	66.67	128	53.33	42.67
181	82.78	66.22	127	52.78	42.22
180	82.22	65.78	126	52.22	41.78
179	81.67	65.33	125	51.67	41.33
178	81.11	64.89	124	51.11	40.89
177	80.55	64.44	123	50.55	40.44
176	80	64	122	50	40
175	79.44	63.56	121	49.44	39.56
174	78.89	63.11	120	48.89	39.11
173	78.33	62.67	119	48.33	38.67
172	77.78	62.22	118	47.78	38.22
171	77.22	61.78	117	47.22	37.78
170	76.67	61.33	116	46.67	37.33
169	76.11	60.89	115	46.11	36.89
168	75.55	60.44	114	45.55	36.44
167	75	60	113	45	36
166	74.44	59.56	112	44.44	35.56
165	73.89	59.11	111	43.89	35.11
164	72.33	58.67	110	43.33	34.67
163	72.78	58.22	109	42.78	34.22
162	71.22	57.78	108	42.22	33.7
161	71.67	57.33	107	41.67	33.33
160	71.11	56.89	106	41.11	32.89
159	70.55	56.44	105	40.55	32.44

KILOGRAMS CONVERTED INTO POUNDS AVOIRDUPOIS.

Kilos.	0	1	2	3	4	5	6	7	8	9
0.0	.000	.022	.044	.066	.088	.110	.132	.154	.176	.194
.1	.220	.243	.265	.287	.309	.331	.353	.375	.397	.419
.2	.441	.463	.485	.507	.529	.551	.573	.595	.617	.639
.3	.661	.683	.705	.728	.750	.772	.794	.816	.838	.860
.4	.882	.904	.926	.948	.970	.992	1.014	1.036	1.058	1.080
.5	1.102	1.124	1.146	1.168	1.190	1.213	1.235	1.257	1.279	1.301
.6	1.323	1.345	1.367	1.389	1.411	1.433	1.455	1.477	1.499	1.521
.7	1.543	1.565	1.587	1.609	1.631	1.653	1.676	1.698	1.720	1.742
.8	1 764	1.786	1.808	1.830	1.852	1.874	1.896	1.918	1.940	1.962
.9	1 984	2.006	2.028	2.050	2.072	2.094	2.116	2.138	2.161	2 183

POUNDS CONVERTED INTO KILOGRAMS.

Pounds.	0	1	2	3	4	5	6	7	8	9
0.0	.000	.005	.009	.014	.018	.023	.027	.032	.036	.041
.1	.045	.050	.054	.059	.064	.068	.073	.077	.082	.086
.2	.091	.095	.100	.104	.109	.113	.118	.122	.127	132
.3	.136	.141	.145	.150	.154	.159	.163	.168	.172	.177
.4	.181	.186	.191	.195	.200	.204	.209	.213	.218	.222
.5	.227	.231	.236	.240	.245	.249	.254	.259	.263	.268
.6	.272	.277	.281	.286	.290	.295	.299	.304	.308	.313
.7	.318	.322	.327	.331	.336	.340	.345	.349	.354	.358
.8	.363	.367	.371	.376	.381	.386	.390	.395	.399	.404
.9	.408	.413	.417	.422	.426	.431	.435	.440	.445	.449

INCHES REDUCED TO DECIMALS OF A FOOT.

(TRAUTWINE.)

Ins.	Foot.	Ins.	Foot.	Ins.	Foot.	Ins.	Foot.	Ins.	Foot.
1/32	.0026	1	.0833	2	.1667	6	.5000	10	.8333
1/16	.0052	1 1/8	.0938	2 1/2	.2083	6 1/2	.5417	10 1/2	.8750
1/8	.0104	1 1/4	.1042	3	.2500	7	.5833	11	.9167
1/4	.0208	1 3/8	.1146	3 1/2	.2917	7 1/2	.6250	11 1/2	.9583
3/8	.0313	1 1/2	.1250	4	.3333	8	.6667	12	1.0000
1/2	.0417	1 5/8	.1354	4 1/2	.3750	8 1/2	.7083		
5/8	.0521	1 3/4	.1458	5	.4167	9	.7500		
3/4	.0625	1 7/8	.1563	5 1/2	.4583	9 1/2	.7917		
7/8	.0729								

OUNCES REDUCED TO DECIMALS OF A POUND.

1 oz. = .06 lb.	9 oz. = .56 lb.
2 " = .13 "	10 " = .63 "
3 " = .19 "	11 " = .69 "
4 " = .25 "	12 " = .75 "
5 " = .31 "	13 " = .81 "
6 " = .38 "	14 " = .88 "
7 " = .43 "	15 " = .94 "
8 " = .50 "	16 " = 1 "

WEIGHT AND MEASURE CONVERSION TABLE.

Units.	Inches to Millimeters.	Millimeters to Inches.	Feet to Meters.	Meters to Feet.	Miles to Kilometers.	Kilometers to Miles.	Miles to Knots.	Knots to Stat. Miles.
1	25.4	.0394	.305	3.28	1.609	.621	.868	1.153
2	50.8	.0787	.610	6.56	3.219	1.243	1.735	2.306
3	76.2	.1181	.914	9.84	4.828	1.864	2 603	3.458
4	101.6	.1575	1.219	13.12	6.437	2.486	3.470	4.611
5	127.0	.1969	1.524	16.40	8.047	3.107	4.338	5.764
6	152.4	.2362	1.829	19.69	9.656	3.728	5.205	6.917
7	177.8	.2756	2.134	22.97	11.265	4.350	6.073	8.070
8	203.2	.3150	2.438	26.25	12.875	4.971	6.940	9.222
9	228.6	.3543	2.743	29.53	14.484	5.593	7.808	10.375

Units.	Sq. Feet to Sq. Meters.	Sq. Meters to Sq. Feet.	Acres to Hectares.	Hectares to Acres.	Cub. Feet to Cub. Meters.	Cub. Meters to Cub. Feet.	Bushels to Hectoliters.	Hectoliters to Bushels.
1	.0929	10.76	.405	2.47	.028	35.3	.35	2.84
2	.1858	21.53	.809	4.94	.057	70.6	.70	5.68
3	.2787	32.29	1.214	7.41	.085	105.9	1.06	8.51
4	.3716	43.06	1.619	9.88	.113	141.3	1.41	11.35
5	.4645	53.82	2.024	12.36	.142	176.6	1.76	14.19
6	.5574	64.58	2.428	14.83	.170	211.9	2.11	17.03
7	.6503	75.35	2.833	17.30	.198	247.2	2.47	19.86
8	.7432	86.11	3.238	19.77	.226	282.5	2.82	22.70
9	.8361	96.88	3.642	22.24	.255	317.8	3.17	25.54

Units.	Fluid Oz. to C.c.	C.c. to Fluid Oz.	Quarts to Liters.	Liters to Quarts.	Gallons to Liters.	Liters to Gallons.	Ounces to Grams.	Ounces to Pounds.
1	29.6	.338	.95	1.06	3.79	.26	28.3	.063
2	59.1	.676	1.89	2.11	7.57	.53	56.7	.125
3	88.7	1.014	2.84	3.17	11.36	.79	85.1	.188
4	118.3	1.352	3.79	4.23	15.14	1.06	113.4	.250
5	147.9	1.690	4.73	5.28	18.92	1.32	141.8	.313
6	177.4	2.028	5.68	6.34	22.71	1.59	170.1	.375
7	207.0	2.366	6.62	7.40	26.50	1.85	198.5	.438
8	236.6	2.704	7.57	8.45	30.28	2.11	226.8	.500
9	266.1	3.042	8.52	9.51	34.07	2.38	255.1	.563

GOVERNMENT LAND MEASURES.

In the system of government survey, lines running north and south are drawn parallel to a fixed line (principal meridian) at a distance of six miles apart; these are called *range lines*. At right angles with these, other parallel lines (*town lines*) are drawn, which then run east and west. The two sets of lines form squares containing 36 square miles each, called *townships*. A certain number of townships form a *county*. Each square mile of a township is called a *section*, containing 640 acres, and these are numbered regularly 1 to 36, commencing at the northeast corner, as shown in the accompanying diagram. Section 16 in each township is set apart for school purposes.

Sections are divided by lines running north and south, and east and west, into *quarter sections*, designated as the northeast quarter, northwest quarter, southwest quarter, and south-east quarter of the section. These quarters contain 160 acres of land each, and are again divided into quarters, each containing forty acres, which is the smallest sub-division recognized in government survey. Lands are usually sold in tracts of forty acres, or a multiple thereof, except in case of land bordering on lakes, which are fractional sections and may contain more or less than forty acres. These are called *government lots*.

TOWNSHIP.

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SECTION.

<table>
<tr><td rowspan="2">N. W. Quarter.</td><td>NW¼ of NE¼</td><td>NE¼ of NE¼</td></tr>
<tr><td>SW¼ of NE¼</td><td>SE¼ of NE¼</td></tr>
<tr><td>S. W. Quarter.</td><td colspan="2">S. E. Quarter.</td></tr>
</table>

The description of a 40-acre lot would then, for example, read as follows: The northeast quarter of the northeast quarter of section 1 in township 24 north, range 7 west.

TO MEASURE CORN ON THE COB IN CRIBS.

(WARING.)

When the Crib is Equilateral.

RULE.—Multiply the length in inches by the breadth in inches, and that again by the height in inches, and divide the product by 2748 (the number of cubic inches in a heaped bushel), and the quotient will be the number of bushels of ears. Take two thirds of the quotient for the number of bushels of shelled corn.

Example.—Required the number of bushels of shelled corn contained in a crib of ears, 15 ft. long by 5 ft. wide and 10 ft. high.

Solution: 180 in. (length) × 60 in. (width) × 120 in. (height) = 1,296,000 ÷ 2748 = 471.6 heaped bushels, two thirds of which is 314.6 bushels, shelled.

When the Crib is Flared at the Sides.

Multiply half the sum of the top and bottom widths in inches by the perpendicular height in inches, and that again by the length in inches, and divide the product by 2748; the quotient will be the number of heaped bushels of ears. Take two-thirds of the quotient for the number of bushels of shelled corn.

HAY AND STRAW IN MOWS OR STACKS.

Four hundred and fifty cubic feet of hay is roughly estimated as a ton, but there is great variation in the ratio of weight to volume, ranging from less than 400 to 500 cu. ft., according to the kind of hay, time of cutting, and height of mow or stack. In general, the finer the stalk of the plant, and the larger the mow, the heavier the hay; also, of course, the more closely packed in putting away, and the nearer the bottom of the mow the heavier. Grass allowed to stand till nearly ripe before cutting will be the lighter; loose hay in loft will take toward 500 cubic feet to the ton; in case of timothy hay about 420, and in case of clover hay, about 500 cubic feet will make a ton. One ton of straw will measure 600–1000 cubic feet, according to kind of straw and length of time in stack or mow. The longer the time in stack, the smaller the number of cubic feet per ton.

In estimating by measurement, multiply together the figures representing the length, width, and height of hay, and

divide the product by the number of feet in a ton. For example, if the hay is 40 ft. long, 16 ft. wide, and 18 ft from the bottom to the top of the mow, and the bulk agreed is 450 cub. ft. to the ton, the mow will contain 40 × 16 × 18, which equals 11,520 cub. ft.; 11,520 divided by 450 equals 25.6, or 25⅗ tons.

The following table is from the *American Agriculturist*

Table for Finding the Value of Hay.

Pounds.	$4	$5	$6	$7	$8	$9	$10	$11
50	0.10	0.13	0.15	0.18	0.20	0.23	0.25	0.28
70	0.14	0.18	0.21	0.25	0.28	0.32	0.35	0.39
90	0.18	0.23	0.27	0.32	0.36	0.41	0.45	0.50
100	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55
300	0.60	0.75	0.90	1.05	1.20	1.35	1.50	1.65
400	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.20
500	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75
700	1.40	1.75	2.10	2.45	2.80	3.15	3.50	3.85
900	1.80	2.25	2.70	3.15	3.60	4.05	4.50	4.95
1000	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50
1200	2.40	3.00	3.60	4.20	4.80	5.40	6.00	6.60
1500	3.00	3.75	4.50	5.25	6.00	6.75	7.50	8.25
1600	3.20	4.00	4.80	5.60	6.40	7.20	8.00	8.80
1700	3.40	4.25	5.10	5.95	6.80	7.65	8.50	9.35
1800	3.60	4.50	5.40	6.30	7.20	8.10	9.00	9.90
1900	3.80	4.75	5.70	6.65	7.60	8.55	9.50	10.45
2000	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00

Pounds.	$12	$13	$14	$15	$16	$17	$18
50	0.30	0.33	0.35	0.38	0.40	0.43	0.45
70	0.42	0.46	0.49	0.53	0.56	0.60	0.63
90	0.54	0.59	0.63	0.68	0.72	0.77	0.81
100	0.60	0.65	0.70	0.75	0.80	0.85	0.90
300	1.80	1.95	2.10	2.25	2.40	2.55	2.70
400	2.40	2.60	2.80	3.00	3.20	3.40	3.60
500	3.00	3.25	3.50	3.75	4.00	4.25	4.50
700	4.20	4.55	4.90	5.25	5.60	5.95	6.30
900	5.40	5.85	6.30	6.75	7.20	7.65	8.10
1000	6.00	6.50	7.00	7.50	8.00	8.50	9.00
1200	7.20	7.80	8.40	9.00	9.60	10.20	10.80
1500	9.00	9.75	10.50	11.25	12.00	12.75	13.50
1600	9.60	10.40	11.20	12.00	12.80	13.60	14.40
1700	10.20	11.05	11.90	12.75	13.60	14.45	15.30
1800	10.80	11.70	12.60	13.50	14.40	15.30	16.20
1900	11.40	12.35	13.30	14.25	15.20	16.15	17.10
2000	12.00	13.00	14.00	15.00	16.00	17.00	18.00

Annual. The price per ton of 2000 lbs. being known, it is easy to find the value of any fraction of a ton at $4 to $18 per ton. If a farmer has 1565 lbs of hay on his wagon, and the dealer has bought it at $7 per ton, he finds by looking across the table from 1500 lbs. to the column at the top of which is $7, that the value of 1500 lbs. at $7 is $5.25, the value of 60 lbs. 21 cents, and the value of 5 lbs. 2 cents, making a total of $5.48.

To find the value of any fraction of a ton at $7.40, $7.60, $7.80, etc., find the value at $7 and add to it one tenth the value at $4, $6, $8, etc.

STRENGTH OF HEMP ROPES.

Hemp rope, 1 in. in circumference, is calculated to sustain a weight of 200 lbs.; 1½ in., 450 lbs.; 2 in., 800 lbs.; 2½ in., 1250 lbs.; 3 in., 1800 lbs.; 4 in., 3200 lbs.; 5 in., 5000 lbs.; 6 in., 7200 lbs. Hemp is considered twice as strong as manila, and wire rope twice as strong as hemp. (*Yearbook U. S. Dept. Agric.*)

The diameters corresponding to the circumferences given are, in the preceding order: .318, .477, .636, .795, .955, 1.27, 1.59, and 1.91 inches.

THE STRENGTH OF MANILA AND WIRE ROPES.

(Cornell Univ.)

Manila Rope. 3 strands, 36 in. long.		Manila Rope. 4 strands, 36 in. long.		Cast-steel Wire Rope. 6 strands.		
Circumference.	Breaking Load.	Circumference.	Breaking Load.	Circumference.	No. of Wires in Strand.	Breaking Load.
ins.	lbs.	ins.	lbs.	ins.		lbs.
1.625	1,750	2.825	4,250	1.062	6	6,285
2.25	3,680	3.375	6,050	1.375	19	11,850
2.375	4,750	3.75	7,700	1.563	19	12,590
2.812	5,400	4.25	11,140	1.595	19	19,500
3.188	6,800	4.825	14,020	1.780	19	19,150
3.625	7,635	5.375	16,550	1.938	19	21,510
4.375	8,980	3.188	7,700	....	....	....
4.75	11,870	3.125	7,630	....	....	....
5.125	15,100	....	....	....	....	....
2.562	2,850	....	....	....	....	....
3.033	4,930	....	....	....	....	....
4.188	11,650	....	....	....	....	....

LEGAL WEIGHTS OF GRAIN, SEEDS, ETC.

The table shows the number of pounds per bushel required by law or custom, in the sale of articles specified, in the several States of the Union.

States.	Barley.	Buckwheat.	Coal.	Corn, Shelled.	Corn Meal.	Onions.	Oats.	Potatoes.	Rye.	Wheat.	Salt.	Turnips.	Beans, White.	Clover-seed.	Timothy.
Maine	48	48	...	56	50	52	32	60	..	60	...	60	62	...	45
New Hampshire	...	...	...	56	50	...	32	60	56	60	..	.	62	..	...
Vermont	48	48	...	56	...	52	32	60	56	60	70	60	62	60	45
Massachusetts	48	48	..	56	50	52	32	60	56	60	..	...	60	60	45
Rhode Island	48	...	...	56	50	50	32	60	56	60	..	...	...	...	...
Connecticut	48	48	...	56	50	50	32	60	56	60	...	50	60	...	...
New York	48	48	...	58	...	...	32	60	56	60	...	...	62	60	44
New Jersey	48	50	...	56	..	57	30	60	56	60	...	...	...	64	45
Pennsylvania	47	48	...	56	48	50	30	60	56	60	85	...	...	62	...
Delaware	...	...	...	56	48	...	...	..	...	60	..	...	...	...	...
Maryland	...	...	...	...	...	...	26	56	56	...	56	...	62	...	...
District of Columbia	47	48	...	56	48	57	32	56	56	60	50	55	62	60	45
Virginia	48	52	...	56	50	57	32	60	56	60	...	56	60	64	45
West Virginia	48	52	80	56	...	...	32	60	56	60	...	..	60	60	45
North Carolina	48	50	...	54	46	...	30	. .	56	60	...	...	...	64	...
South Carolina	48	56	80	56	50	57	32	60	56	60	50	...	60	60	...
Georgia	47	52	80	56	48	57	32	60	56	60	56	55	...	60	45
Florida	48	48	...	56	48	57	32	60	56	60	...	55	60	60	45
Alabama	47	48	...	56	48	57	32	60	56	60	...	55	60	60	45
Mississippi	48	...	...	56	48	..	32	60	56	60	...	...	60	60	45
Louisiana	...	...	...	56	50	...	32	..	...	...	...	...	..	...	...
Texas	48	42	...	56	...	57	32	60	56	60	...	55	60	60	45
Arkansas	48	52	80	56	48	57	32	60	56	60	50	57	60	60	60
Tennessee	48	50	...	56	50	56	32	60	56	60	...	50	60	60	45
Kentucky	47	56	...	56	50	57	32	60	56	60	50	60	60	60	45
Ohio	48	50	..	56	...	55	32	60	56	60	...	60	60	60	45
Michigan	48	48	80	56	50	54	32	60	56	60	56	58	60	60	45
Indiana	48	50	70	56	50	48	32	60	56	60	50	...	60	60	45
Illinois	48	52	..	56	48	57	32	60	56	60	50	55	60	60	45
Wisconsin	48	48	...	56	50	57	32	60	56	60	...	42	60	60	45
Minnesota	48	50	...	56	...	57	32	60	56	60	...	52	60	60	45
Iowa	48	52	...	56	...	57	32	60	56	60	50	...	60	60	45
Missouri	48	52	...	56	50	57	32	60	56	60	50	42	60	60	45
Kansas	48	50	...	56	50	57	32	60	56	60	50	55	60	60	45
Nebraska	48	52	...	56	...	52	32	60	56	60	50	55	60	60	45
South Dakota	48	42	...	56	...	52	32	60	56	60	...	60	60	60	42
North Dakota	48	42	...	56	...	57	32	60	56	60	. .	60	60	60	42
Montana	48	52	...	56	50	57	32	60	56	60	...	50	60	60	45
Colorado	48	52	...	56	50	...	32	60	56	60	...	...	60	60	45
Idaho	48	42	...	56	...	...	36	60	56	60	...	...	...	60	...
Washington	48	42	...	56	. .	...	32	60	56	60	...	...	...	...	40
California	50	40	...	52	...	...	32	...	54	60	...	...	...	...	...
Oregon	46	42	...	56	...	...	36	60	56	60	...	...	...	60	...
Oklahoma	48	42	...	56	...	52	32	60	56	60	...	60	...	60	45
United States	48	42	80	56	48	...	32	60	56	60	..	..	...	..	...

COMMERCIAL GRADES OF GRAIN.

(Minneapolis and Duluth Grain Inspection Board.)

I. WHEAT.

No. 1 *Hard Spring Wheat.*—No. 1 Hard Spring Wheat must be sound, bright, and well cleaned, and must be composed mostly of Hard Scotch Fife, and weigh not less than fifty-eight pounds to the measured bushel.

No. 1 *Northern Spring Wheat.*—No. 1 Northern Spring Wheat must be sound and well cleaned; it may be composed of the hard and soft varieties of spring wheat, but must contain a larger proportion of the hard varieties, and weigh not less than fifty-seven pounds to the measured bushel.

No. 2 *Northern Spring Wheat.*—No. 2 Northern Spring Wheat must be reasonably sound and clean and of good milling quality, this grade to include all wheat not suitable for the higher grades, and must weigh not less than fifty-six pounds to the measured bushel.

No. 3 *Spring Wheat.*—No. 3 Spring Wheat shall comprise all inferior, shrunken spring wheat, weighing not less than fifty-four pounds to the measured bushel.

No. 4 *Spring Wheat.*—No. 4 Spring Wheat shall include all inferior spring wheat that is badly shrunken or damaged, and must weigh not less than forty-nine pounds to the measured bushel.

Rejected Spring Wheat.—Rejected Spring Wheat shall include all spring wheat grown, badly bleached, or for any other cause unfit for No. 4 Wheat.

NOTE.—Hard, flinty wheat of good color, containing no appreciable admixture of soft wheat, may be admitted into the grades of No. 2 Northern Spring and No. 3 Northern Spring Wheat, provided weight of the same is not more than one pound less than the minimum test weight required by the existing rules for said grades, and provided further that such wheat is in all other respects qualified for admission into such grades.

GOVERNMENT LAND MEASURES.

In the system of government survey, lines running north and south are drawn parallel to a fixed line (principal meridian) at a distance of six miles apart; these are called *range lines*. At right angles with these, other parallel lines (*town lines*) are drawn, which then run east and west. The two sets of lines form squares containing 36 square miles each, called *townships*. A certain number of townships form a *county*. Each square mile of a township is called a *section*, containing 640 acres, and these are numbered regularly 1 to 36, commencing at the northeast corner, as shown in the accompanying diagram. Section 16 in each township is set apart for school purposes.

Sections are divided by lines running north and south, and east and west, into *quarter sections*, designated as the northeast quarter, northwest quarter, southwest quarter, and south-east quarter of the section. These quarters contain 160 acres of land each, and are again divided into quarters, each containing forty acres, which is the smallest sub-division recognized in government survey. Lands are usually sold in tracts of forty acres, or a multiple thereof, except in case of land bordering on lakes, which are fractional sections and may contain more or less than forty acres. These are called *government lots*.

TOWNSHIP.

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SECTION.

<table>
<tr><td rowspan="2">N. W. Quarter.</td><td>NW¼ of NE¼</td><td>NE¼ of NE¼</td></tr>
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</table>

The description of a 40-acre lot would then, for example, read as follows: The northeast quarter of the northeast quarter of section 1 in township 24 north, range 7 west.

TO MEASURE CORN ON THE COB IN CRIBS.

(WARING.)

When the Crib is Equilateral.

RULE.—Multiply the length in inches by the breadth in inches, and that again by the height in inches, and divide the product by 2748 (the number of cubic inches in a heaped bushel), and the quotient will be the number of bushels of ears. Take two thirds of the quotient for the number of bushels of shelled corn.

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Solution: 180 in. (length) $\times$ 60 in. (width) $\times$ 120 in. (height) $= 1,296,000 \div 2748 = 471.6$ heaped bushels, two thirds of which is 314.6 bushels, shelled.

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In estimating by measurement, multiply together the figures representing the length, width, and height of hay, and

white, reasonably dry and reasonably clean, but not sufficiently sound for No. 2.

No. 1 *Corn.*—No. 1 Corn shall be mixed corn of choice quality, sound, dry, and well cleaned.

No. 2 *Corn.*—No. 2 Corn shall be mixed corn, dry, reasonably clean, but not good enough for No. 1.

No. 3 *Corn.*—No. 3 Corn shall be mixed corn, reasonably dry and reasonably clean, but not sufficiently sound for No. 2.

No. 4 *Corn.*—No. 4 Corn shall include all corn not wet and not in heating condition that is unfit for No. 3.

III. OATS.

No. 1 *White Oats.*—No. 1 White Oats shall be white, dry, sweet, sound, clean, and free from other grain, and shall weigh not less than thirty-two pounds to the measured bushel.

No. 2 *White Oats.*—No. 2 White Oats shall be seven-eighths white, dry, sweet, sound, reasonably clean, and practically free from other grain, and shall weigh not less than thirty-one pounds to the measured bushel.

No. 3 *White Oats.*—No. 3 White Oats shall be seven-eighths white, dry, sweet, sound, reasonably clean, and practically free from other grain, and shall weigh not less than twenty-nine pounds to the measured bushel.

No. 4 *White Oats.*—Shall include all oats not sufficiently sound and clean for No. 3 White Oats, and shall weigh not less than twenty-five pounds to the measured bushel.

Yellow Oats.—The grades of Nos. 1, 2, and 3 Yellow Oats shall correspond with the grades of Nos. 1, 2, and 3 White Oats, excepting that they shall be of the yellow varieties.

No. 1 *Oats.*—No. 1 Oats shall be dry, sweet, sound, clean, and free from other grain, and shall weigh not less than thirty-two pounds to the measured bushel.

No. 2 *Oats.*—No. 2 Oats shall be dry, sweet, sound, reasonably clean, and practically free from other grain, and shall weigh not less than thirty-one pounds to the measured bushel.

No. 3 *Oats.*—No. 3 Oats shall be all oats that are merchantable and warehousable and not fit for the higher grades.

No. 1 *Clipped White Oats.*—No. 1 Clipped White Oats shall be white, dry, sweet, sound, clean, and free from other grain, and shall weigh not less than forty pounds to the measured bushel.

No. 2 *Clipped White Oats.*—No. 2 Clipped White Oats shall be seven-eighths white, dry, sweet, sound, reasonably clean, and practically free from other grain, and shall weigh not less than thirty-eight pounds to the measured bushel.

No. 3 *Clipped White Oats.*—No. 3 Clipped White Oats shall be seven-eighths white, dry, sweet, sound, reasonably clean, and practically free from other grain, and shall weigh not less than thirty-six pounds to the measured bushel.

IV. RYE.

No. 1 *Rye.*—No. 1 Rye shall be sound, plump, and well cleaned, and shall weigh not less than fifty-six pounds to the measured bushel.

No. 2 *Rye.*—No. 2 Rye shall be sound, reasonably clean, and reasonably free from other grain, and shall weigh not less than fifty-four pounds to the measured bushel.

No. 3 *Rye.*—All rye slightly damaged, slightly musty, or from any other cause unfit for No. 2 shall be graded as No. 3.

V. BARLEY.

No. 1 *Barley.*—No. 1 Barley shall be plump, bright, clean, and free from other grain, and shall weigh not less than forty-eight pounds to the measured bushel.

No. 2 *Barley.*—No. 2 Barley shall be sound and of healthy color, not plump enough for No. 1, reasonably clean, and reasonably free from other grain, and shall weigh not less than forty-six pounds to the measured bushel.

No. 3 *Barley.*—No. 3 Barley shall include all slightly shrunken and otherwise slightly damaged barley not good enough for No. 2, and shall weigh not less than forty-four pounds to the measured bushel.

No. 4 *Barley.*—No. 4 Barley shall include all barley fit for malting purposes not good enough for No. 3.

No. 1 *Feed Barley.*—No. 1 Feed Barley must test not less than

forty pounds to the measured bushel, and be reasonably sound and reasonably clean.

No. 2 Feed Barley.—No. 2 Feed Barley shall include all barley which is for any cause unfit for the grade of No. 1 Feed Barley.

Chevalier Barley.—Nos. 1, 2, and 3 Chevalier Barley shall conform in all respects to the grades of Nos. 1, 2, and 3 Barley, except that they shall be of a Chevalier variety, grown in Montana, Oregon, and on the Pacific Coast.

No Grade.—All Wheat, Barley, Oats, Rye, and Corn that is in a heating condition, too musty or too damp to be safe for warehousing, or that is badly bin-burnt, badly damaged, exceedingly dirty, or otherwise unfit for store, shall be classed as No Grade with inspector's notation as to quality and condition.

VI. FLAXSEED.

All flaxseed inspected shall be classed according to quality and conditions as follows:

No. 1 Northwestern Flaxseed.—Flaxseed to grade No. 1 Northwestern shall be mature, sound, dry, and sweet. It shall be northern grown. The maximum quantity of field, stack, storage, or other damaged seed intermixed shall not exceed twelve and one-half (12½) per cent. The minimum weight shall be fifty-one (51) pounds to the measured bushel of commercially pure seed.

No. 1 Flaxseed.—No. 1 Flaxseed shall be northern grown, sound, dry, and free from mustiness, and carrying not more than twenty-five (25) per cent of immature or field, stack, storage, or other damaged flaxseed, and weighing not less than fifty (50) pounds to the measured bushel of commercially pure seed.

No. 2 Flaxseed.—Flaxseed that is bin-burnt, immature, field damaged, or musty, and yet not to a degree to be unfit for storage, and having a test weight of not less than forty-seven (47) pounds to the bushel of commercially pure seed shall be No. 2 Flaxseed.

No Grade Flaxseed.—Flaxseed that is damp, warm, moldy, very musty, or otherwise unfit for storage, or having a weight of less than forty-seven (47) pounds to the measured bushel of commercially pure seed shall be No Grade.

GRADES OF HAY AND STRAW.

(National Hay Association, 1909.)

A. Hay.

Choice Timothy Hay.—Shall be timothy not mixed with over one-twentieth other grasses, properly cured, bright, natural color, sound, and well baled.

No. 1. *Timothy Hay.*—Shall be timothy not more than one-eighth mixed with clover or other tame grasses, properly cured, good color, sound, and well baled.

No. 2, *Timothy Hay.*—Shall be timothy not good enough for No. 1, not over one-fourth mixed with clover or tame grasses, fair color, sound and well baled.

No. 3, *Timothy Hay.*—Shall include all hay not good enough for other grades, sound, and well baled.

Light Clover-mixed Hay. — Shall be timothy mixed with clover, the clover-mixture not over one-fourth, properly cured, sound, good color, and well baled.

No. 1, *Clover mixed Hay* —Shall be timothy and clover mixed, with at least one-half timothy, good color, sound, and well baled.

No, 2, *Clover-mixed Hay.* — Shall be timothy and clover mixed, with at least one-third timothy, reasonably sound, and well baled.

No. 1, *Clover Hay.*—Shall be medium clover, not over one-twentieth other grasses, properly cured, sound, and well baled.

No. 2, *Clover Hay.*—Shall be clover, sound, well baled, not good enough for No. 1.

No Grade Hay.—Shall include all hay badly cured, stained, thrashed, or in any way unsound.

Choice Prairie Hay.—Shall be upland hay, of bright natural color, well cured, sweet, sound, and may contain 3 per cent of weeds.

No. 1, *Prairie Hay.*—Shall be upland, and may contain one-quarter midland, both of good color, well cured, sweet, sound, and may contain 8 per cent of weeds.

No. 2, *Prairie Hay.*—Shall be upland of fair color, and may contain one-half midland, both of good color, well cured, sweet, sound, and may contain 12½ per cent of weeds.

No. 3, *Prairie Hay* —Shall include hay not good enough for other grades and not caked.

No. 1, *Midland Hay*.—Shall be hay of good color, well cured, sweet, sound, and may contain 3 per cent of weeds.

No. 2, *Midland Hay*—Shall be fair color or slough hay of good color and may contain 12½ per cent of weeds.

Packing Hay.—Shall include all wild hay not good enough for other grades and not caked.

No-grade Prairie Hay.—Shall include all hay not good enough for other grades.

Choice Alfalfa—Shall be reasonably fine, leafy alfalfa of bright green color, properly cured, sound, sweet, and well baled.

No. 1, *Alfalfa*.—Shall be coarse alfalfa of natural color or reasonably fine, leafy alfalfa of good color, and may contain 5 per cent of foreign grasses, must be well baled, sound, and sweet.

No 2, *Alfalfa*—Shall include alfalfa somewhat bleached, but of fair color, reasonably leafy, not more than one-eighth foreign grasses, sound, and well baled.

No. 3, *Alfalfa*.—Shall include bleached alfalfa or alfalfa mixed with not to exceed one-fourth foreign grasses, but when mixed must be of fair color, sound, and well baled.

No-grade Alfalfa.—Shall include all alfalfa not good enough for other grades, caked, musty, greasy, or thrashed.

B. Straw.

No. 1, *Straight Rye Straw*.—Shall be in large bales, clean, bright, long rye straw, pressed in bundles, sound, and well baled.

No. 2, *Straight Rye Straw*.—Shall be in large bales, long rye straw, pressed in bundles, sound, and well baled, not good enough for No. 1.

No. 1, *Tangled Rye Straw*.—Shall be reasonably clean rye straw, good color, sound, and well baled.

No. 2, *Tangled Rye Straw*.—Shall be reasonably clean, may be some stained, but not good enough for No. 1.

No. 1, *Wheat Straw*.—Shall be reasonably clean wheat straw, sound, and well baled.

No. 2, *Wheat Straw*.—Shall be reasonably clean, may be some stained, but not good enough for No. 1.

No. 1, *Oat Straw*.—Shall be reasonably clean oat straw, sound, and well baled.

No. 2, *Oat Straw*.—Shall be reasonably clean, may be some stained, but not good enough for No. 1.

SPECIFIC GRAVITY OF VARIOUS SUBSTANCES

(TRAUTWINE.)

	Average Specific Gravity.	Average Weight of 1 cu. foot, in Pounds.
Aluminum	2.6	162.
Anthracite, 1.3–1.84, usually	1.5	93.5
" broken, of any size, loose		52–56
(A ton, loose, averages from 40 to 43 cubic feet.)		
Ash, American white, dry	.61	38.
" " " perfectly dry	.752	47.
Asphaltum, 1–1.8	1.4	83.3
Boxwood, dry	.96	60.
Brass (copper and zinc) cast, 7.8–8.4	8.1	504.
Bronze (copper 8 parts, tin 1 part, gun metal), 8.4–8.6	8.5	529.
Cement, English Portland	....	81–106
Charcoal, of pines and oaks	....	15–30
Cherry, perfectly dry	.672	42.
Chestnut, perfectly dry	.66	41.
Coal, bituminous 1.2–1.5	1.35	84.
broken, of any size, loose		47–52
(A ton occupies from 43 to 48 cubic feet.)		
Copper, cast, 8.6–8.8	8.7	542.
Cork	.25	15.6
Coke, loose, of good coal	....	23–32
(A ton occupies 80 to 97 cubic feet.)		
Elm, perfectly dry	.56	35.
Fat	.93	58.
Glass, 2.5–3.45		
Gold, cast, pure	19.258	1204.
Gravel, about the same as sand, which see.		
Hemlock, perfectly dry	.4	25.
Hickory, perfectly dry	.85	53.
Ice, .917–.922	.92	57.4
India rubber	.93	58.
Iron, cast, 6.9–7.4	7.15	446.
Lard	.95	59.3
Lead, 11.38–11.47	11.38	709.6
Lime, quick	1.5	95.
" " ground loose, per struck bu. 62–72 lbs.		
Limestone and marbles	2.6	164.4
Mahogany, Spanish, dry	.85	53.
Maple, dry	.79	49.
Mercury, at 60° F	13.58	846.
Oak, white, perfectly dry, .66–.88	.77	48.

SPECIFIC GRAVITY OF VARIOUS SUBSTANCES.—

Continued.

	Average Specific Gravity.	Average Weight of 1 cu. foot, in Pounds.
Oak, red, black, etc		32–45
" live, .88–1.02	.95	59.3
Oils, olive, whale	.92	57.3
Peat	....	20–30
Petroleum	.878	54.8
Pine, white, perfectly dry, .35–.45	.40	25.
" yellow, Northern, .48 to .62	.55	34.3
" " Southern, .64–.80	.72	45.
Platinum, 21–22	21.5	1342.
Quartz, common, pure, 2.64–2.67	2.65	165
Rosin	1.1	68.6
Salt, coarse, per struck bu., Syracuse, N. Y., 56 lbs.	....	45.
Sand of pure quartz, dry and loose, per struck bu. 112–133 lbs.	....	90–106
Sand of pure quartz, wet	...	118–129
Silver	10.5	655.
Snow, fresh fallen		5–12
" moistened and compacted by rain		15–20
Soils, common loam, perfectly dry, loose		72–80
Soils, common loam, perfectly dry, moderately rammed	....	90–100
Soils, common loam, slightly moist, loose	....	70–76
" " " as a soft, flowing mud	....	104–112
Spruce, perfectly dry	.4	25.
Sulphur	2.0	125.
Steel, 7.7–7.9	7.85	490.
Sycamore, perfectly dry	.59	37.
Tar	1.0	62.4
Tin, cast	7.35	459.
Walnut, perfectly dry	.61	38.
Water, pure rain or distilled, at 32° F. (barometer 30 in.)	....	62.417
Water, pure rain or distilled at 62° F. (barometer 30 in.)	1.0	62.355
Water, pure rain or distilled water at 212° F. (barometer 30 in.)	....	59.7
Water, sea, 1.026–1.030	1.028	64.08
Wax, bees'	.97	60.5
Zinc, 6.8–7.2	7.0	437.5

NOTE.—Green timbers usually weigh from one fifth to nearly one half more than dry and ordinary building timbers when tolerably seasoned; about one sixth more than perfectly dry.

VALUES OF FOREIGN COINS.

A. *Countries with fixed Currencies.*

Countries.	Standard.	Monetary Unit.	Value in Terms of U. S. Gold.	Coins.
Argentine Republic	Gold.	Peso (= 100 centesimos)	$.96,5	*Gold*—Argentine ($4.82,4) and ½ Argentine; *silver*—peso and divisions
Austria-Hungary	Gold.	Crown (= 100 heller)	.20,3	*Gold*—20 crowns ($4.05,2) and 10 crowns. 1 florin = 2 crowns.
Belgium	Gold.	Franc (= 100 centimes)	.19,3	*Gold*—10 and 20 francs, *silver*—5 francs.
Brazil	Gold.	Milreis (= 1000 reis)	.54,6	*Gold*—5, 10, and 20 milreis; *silver*—½, 1, and 2 milreis.
Chile	Gold.	Peso (= 100 centavos)	.36,5	*Gold*—escudo ($1.25), doubloon ($3.65), and condor ($7.30); *silver*—peso and divisions.
Costa Rica	Gold.	Colon (= 100 centesimos)	.46,5	*Gold*—2, 5, 10, and 20 colons; *silver*—5, 10, 25, and 50 centesimos.
Cuba	Gold and s.	Peso (= 100 centavos)	.92,6	*Gold*—doubloon ($5.01,7); *silver*—peso (60 cents).
Denmark	Gold.	Crown (krone) (= 100 oere)	.26,8	*Gold*—10 and 20 crowns.
Ecuador	Gold.	Sucre	.48,7	*Gold*—10 sucres ($4.86,6½); *silver*—sucre and divisions.
Egypt	Gold.	Pound (= 100 piasters)	4.94,3	*Gold*—10, 20, 50, and 100 piasters; *silver*—1, 2, 10, and 20 piasters.
Finland	Gold.	Mark (= 100 penni)	.19,3	*Gold*—10 and 20 marks ($1.93 and $3.85,9).
France	Gold.	Franc (= 100 centimes)	.19,3	*Gold*—5, 10, 20, 50, and 100 francs; *silver*—5 francs.
Germany	Gold.	Mark (= 100 pfennig)	.23,8	*Gold*—5, 10, and 20 marks.
Great Britain	Gold.	Pound sterling (= 20 shillings)	4.86,6½	*Gold*—sovereign (pound sterling) and half sovereign.
Greece	Gold.	Drachma (= 100 lepta)	.19,3	*Gold*—5, 10, 20, 50, and 100 drachmas; *silver*—5 drachmas.
Haiti	Gold.	Gourde	.96,5	*Silver*—gourde.
India	Gold.	Rupee (= 16 annas)	.32,4	*Gold*—sovereign ($4.86,6½); *silver*—rupee and divisions.
Italy	Gold.	Lira (= 100 centesimi)	.19,3	*Gold*—5, 10, 20, 50, and 100 lire; *silver*—5 lire.
Japan	Gold.	Yen (= 100 sens)	.49,8	*Gold*—1, 2, 5, 10, and 20 yen.
Liberia	Gold.	Dollar (= 100 cents)	1.00	
Netherlands	Gold.	Florin (= 100 cents)	.40,2	*Gold*—10 florins; *silver*—½, 1, and 2½ florins.
Norway	Gold.	Crown (krone) (= 100 oere)	.26,8	*Gold*—10 and 20 crowns.
Peru	Gold.	Sol (= 100 centesimos)	.48,7	*Gold*—libra ($4.86,6½), *silver*—sol and divisions.
Portugal	Gold.	Milreis (= 1000 reis)	1.08	*Gold*—1, 2, 5, and 10 milreis.
Russia	Gold.	Ruble (= 100 kopecks)	.51,5	*Gold*—imperial ($7.71,8) and ½ imperial ($3.80); *silver*—¼, ½, and 1 ruble.
Spain	Gold.	Peseta (= 100 centesimos)	.19,3	*Gold*—25 pesetas, *silver*—5 pesetas.
Sweden	Gold.	Crown (krona) (= 100 oere)	.26,8	*Gold*—10 and 20 crowns.
Switzerland	Gold.	Franc (= 100 centimes)	.19,3	*Gold*—5, 10, 20, 50, and 100 francs; *silver*—5 francs.
Turkey	Gold.	Piaster (= 1/100 lira)	.04,4	*Gold*—25, 50, 100, 200, and 500 piasters.
Uruguay	Gold.	Peso	1.03,4	*Gold*—peso; *silver*—peso and divisions.
Venezuela	Gold.	Bolivar	.19,3	*Gold*—5, 10, 20, 50, and 100 bolivars, *silver*—5 bolivars.

B. *Countries with Fluctuating Currencies.*

			about
Bolivia..........	Gold.	Boliviano (=100 centavos)	$0.38,9
Central America..	Gold.	Peso	.38,9
China...........	Silver	Shanghai tael	.69,2
		Haikwan tael (customs)	.77,1
Colombia........	Gold.	Dollar.	1.00
Mexico..........	Gold.	Dollar (peso) (=100 centavos)	.49,8
Persia...........	Gold.	Kran	.17,04
Tripoli..........	Silver.	Mahbub (=20 piasters)	.44

MONEY CONVERSION TABLE.

	£ Sterling (Great Britain).	Mark (Germany).	Franc, lira (France, Italy, etc.).	Florin (Netherlands).	Gold Ruble (Russia).	Krone (Scand. Countries).	Crown (Austria).
1	$ 4.87	$ 0.24	$ 0.19	$ 0.40	$ 0.52	$ 0.27	$ 0.20
2	9.73	.48	.39	.80	1.03	.54	.41
3	14.60	.71	.58	1.21	1.55	.80	.61
4	19.47	.95	.77	1.61	2.06	1.07	.81
5	24.33	1.19	.97	2.01	2.58	1.34	1.02
6	29.20	1.43	1.16	2.41	3.09	1.61	1.22
7	34.07	1.67	1.35	2.81	3.61	1.88	1.42
8	38.93	1.90	1.54	3.22	4.12	2.14	1.62
9	43.80	2.14	1.74	3.62	4.64	2.41	1.83
10	48.67	2.38	1.93	4.02	5.15	2.68	2.03
20	97.33	4.76	3.86	8.04	10.30	5.36	4.06
30	146.00	7.14	5.79	12.06	15.45	8.04	6.09
40	194.66	9.52	7.72	16.08	20.60	10.72	8.12
50	243.33	11.90	9.65	20.10	25.75	13.40	10.15
100	486.65	23.80	19.30	40.20	51.50	26.80	20.30

IV. STATISTICAL TABLES.

AREA AND POPULATION OF THE UNITED STATES, 1910. (Thirteenth Census.)

States or Territories.	Land Area, Sq. Mi.	Population.	States or Territories.	Land Area Sq. Mi.	Population.
Alabama.....	51,279	2,138,093	N. Hampshire..	9,031	430,572
Arizona......	113,810	204,354	New Jersey....	7,514	2,537,167
Arkansas.....	52,525	1,574,449	New Mexico...	122,503	327,301
California....	155,652	2,377,549	New York....	47,654	9,113,614
Colorado.....	103,658	799,024	N. Carolina....	48,740	2,206,287
Connecticut ..	4,820	1,114,756	N. Dakota.....	70,183	577,056
Delaware.....	1,965	202,322	Ohio..........	40,740	4,767,121
D. of Colum..	60	331,069	Oklahoma.....	69,414	1,657,155
Florida.......	54,861	752,619	Oregon........	95,607	672,765
Georgia......	58,725	2,609,121	Pennsylvania..	44,832	7,665,111
Idaho........	83,354	325,594	Rhode Island..	1,067	542,610
Illinois.......	56,043	5,638,591	S. Carolina....	30,495	1,515,400
Indiana......	36,045	2,700,876	S. Dakota.....	76,868	583,888
Iowa.........	55,586	2,224,771	Tennessee.....	41,687	2,184,789
Kansas.......	81,774	1,690,949	Texas.........	262,398	3,896,542
Kentucky....	40,181	2,289,905	Utah..........	82,184	373,351
Louisiana.....	45,409	1,656,388	Vermont......	9,124	355,956
Maine.......	29,895	742,371	Virginia.......	40,262	2,061,612
Maryland....	9,941	1,295,346	Washington....	66,836	1,141,990
Massachustts	8,039	3,366,416	W. Virginia....	24,022	1,221,119
Michigan.....	57,480	2,810,173	Wisconsin.....	55,256	2,233,860
Minnesota....	80,858	2,075,708	Wyoming......	97,594	145,965
Mississippi ...	46,362	1,797,114			
Missouri.....	68,727	3,293,335	Total.......	2,973,890	91,972,266
Montana.....	146,201	376,053			
Nebraska.....	76,808	1,192,214	Alaska........	590,884	64,356
Nevada......	109,821	81,875	Hawaii........	6,449	191,909
			Porto Rico....	3,435	1,118,012

AREA AND POPULATION OF CANADA, 1911.

Provinces and Districts.	Land Area, Sq. Mi.	Population.	Provinces and Districts.	Land Area, Sq. Mi.	Population.
Ontario......	365,880	2,523,274	Pr. Ed. Island..	2,184	93,728
Quebec.......	690,865	2,003,232	Saskatchewan. .	243,382	492,432
Nova Scotia..	21,068	492,338	Alberta.......	252,925	374,663
N. Brunswick.	27,911	351,889	Yukon........	206,427	8,512
Manitoba....	231,926	455,614	N. W. Territ's..	1,207,926	18,481
Brit. Colum...	353,416	392,480			
			Total.......	3,603,910	7,206,643

NORMAL MEAN TEMPERATURE OF THE AIR IN THE UNITED STATES.

(In Degrees Fahrenheit.)

(U. S. Weather Bureau.)

Divisions.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
New England States	26.6	28.1	33.1	43.4	53.9	62.8	68.5	67.1	61.1	50.8	41.6	32.1
Middle Atlantic States	33.2	35.8	40.3	51.7	62.5	71.2	76.0	73.4	67.4	56.8	46.2	37.4
South Atlantic States	47.0	50.6	53.8	61.7	70.5	76.9	80.6	78.4	73.8	65.2	55.9	49.0
Florida Peninsula	64.4	65.8	68.4	73.0	76.9	80.6	82.7	82.0	80.0	76.3	71.0	66.9
East Gulf States	49.7	55.2	58.2	66.7	73.0	78.9	81.4	79.9	76.0	67.6	58.1	52.6
West Gulf States	46.2	52.5	58.8	67.0	73.2	79.5	82.8	81.0	75.9	67.9	57.8	51.1
Ohio Valley and Tennessee	33.6	38.8	44.9	55.5	65.2	73.2	77.3	74.3	68.4	57.8	46.9	38.5
Lower Lake Region	24.7	26.7	32.4	44.2	56.3	65.9	71.8	68.4	62.4	51.5	40.7	31.2
Upper Lake Region	17.2	19.3	26.9	40.3	51.3	61.5	67.9	65.1	58.5	47.4	34.9	25.0
North Dakota	.2	6.0	21.2	40.6	53.4	63.5	68.6	65.8	55.4	42.5	26.0	11.1
Upper Mississippi Valley	19.6	25.3	36.1	50.8	60.8	70.3	75.5	71.8	64.2	52.8	39.4	28.2
Missouri Valley	19.8	25.6	36.7	52.2	61.0	71.4	76.1	72.9	65.1	33.3	39.6	28.6
Northern Slope	15.3	21.5	33.0	45.1	53.9	63.6	70.1	68.2	58.2	46.1	32.9	24.4
Middle Slope	25.6	33.1	41.8	52.4	61.6	71.1	76.5	74.0	65.7	54.2	41.6	33.8
Southern Slope	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Southern Plateau	42.6	48.7	55.2	62.1	70.3	78.6	81.4	79.5	72.4	63.8	52.7	47.0
Middle Plateau	28.5	34.2	41.7	49.2	56.0	63.6	71.4	70.6	61.3	49.8	39.6	33.7
Northern Plateau	22.1	25.7	37.6	47.6	56.0	61.4	69.6	69.2	59.0	48.3	36.9	30.3
N. Pac. Coast Region	39.0	40.8	45.6	49.4	54.3	57.8	61.2	60.9	57.7	52.1	46.3	42.7
Middle Pac. Coast Region	47.1	49.3	53.0	55.5	59.3	62.3	64.6	65.1	63.3	60.5	53.5	49.3
South Pac. Coast Region	50.4	53.2	56.5	60.4	64.4	69.1	73.6	74.5	71.1	64.5	58.2	53.0

AVERAGE AND ACTUAL DATE OF LAST AND FIRST KILLING FROST.

(U. S. Weather Bureau.)

State.	Locality.	Spring.		Fall.
		Average.	Last.	Earliest.
Alabama	Mobile	Feb. 24	April 6	Nov. 2
"	Montgomery	Mar. 10	April 6	Oct. 21
Arkansas	Little Rock	Mar. 21	April 14	Oct. 8
"	Fort Smith	Mar. 22	April 6	Oct. 7
Colorado	Denver	May 25	June 6	Sept. 10
Connecticut	New Haven	May 30	May 30	Sept. 15
Dist. of Col	Washington	April 4	April 20	Oct. 4
Florida	Cedar Key	Feb. 4	Mar. 12	Nov. 25
"	Jacksonville	Feb. 24	Mar. 27	Nov. 12
"	Pensacola	Mar. 7	April 6	Nov. 12
Georgia	Atlanta	Mar. 25	May 21	Oct. 16
"	Augusta	Mar. 17	April 5	Oct. 8
"	Savannah	Mar. 1	April 5	Nov. 2
Illinois	Cairo	Mar. 31	May 8	Oct. 2
"	Chicago	April 23	May 25	Sept. 27
"	Springfield	April 16	May 25	Sept. 13
Indiana	Indianapolis	April 17	May 21	Sept. 26
Iowa	Des Moines	April 24	May 31	Sept. 12
"	Dubuque	April 27	May 23	Sept. 5
"	Keokuk	April 10	May 2	Sept. 18
Kansas	Dodge City	April 22	May 23	Sept. 23
"	Leavenworth	April 6	May 21	Sept. 13
Kentucky	Louisville	April 8	May 15	Sept. 30
Louisiana	New Orleans	Feb. 2	Mar. 27	Nov. 11
"	Shreveport	Feb. 26	Mar. 31	Oct. 13
Maine	Portsmouth	April 14	May 5	Sept. 7
Maryland	Baltimore	April 6	May 3	Oct. 6
Massachusetts	Boston	....	May 17	Sept. 30
Michigan	Detroit	May 2	May 28	Sept. 23
"	Grand Haven	May 30	May 28	Aug. 21
"	Marquette	May 18	June 11	Aug. 22
Minnesota	St. Paul	May 1	May 25	Sept. 1
"	Duluth	May 6	June 8	Sept. 13
"	Moorhead	May 18	June 5	Aug. 25
Mississippi	Vicksburg	Mar. 3	April 22	Oct. 19
Missouri	St. Louis	Mar. 31	May 2	Oct. 14
Nebraska	Omaha	April 15	....	Sept. 20
"	North Platte	May 1	....	Sept. 10
New Jersey	Atlantic City	April 6	April 29	Oct. 4
"	Cape May	April 6	May 3	Oct. 29
New Mexico	Santa Fé	April 22	May 22	Sept. 19
New York	Albany	April 21	May 22	Oct. 15
"	Buffalo	May 27	May 29	Sept. 21
"	New York	April 14	April 25	Oct. 15
"	Oswego	April 26	May 29	Sept. 26
"	Rochester	May 3	May 29	Sept. 26
North Carolina	Charlotte	April 1	May 3	Oct. 8
"	Hatteras	Feb. 27	April 5	Nov. 22

DATE OF LAST AND FIRST KILLING FROST—*Continued.*

State.	Locality.	Spring. Average.	Spring. Last.	Fall. Earliest.
North Carolina	Manteo	Mar. 14	April 19	Oct. 16
"	Wilmington.	Mar. 15	April 20	Oct. 13
North Dakota	Bismarck	......	June 6	......
"	St. Vincent	......	June 8	Aug. 4
Ohio	Cincinnati	April 15	May 22	Sept. 30
"	Cleveland	April 26	June 6	Sept. 24
"	Columbus	April 18	May 17	Sept 29
"	Sandusky	April 9	May 23	Oct. 8
"	Toledo	April 24	May 23	Sept. 9
Oklahoma	Fort Sill	Mar. 15	April 13	Oct. 1
Pennsylvania	Erie	April 25	May 29	Sept. 16
"	Philadelphia	April 5	April 29	Oct. 2
"	Pittsburg.	April 27	May 22	Sept. 25
South Carolina	Charleston	Feb. 24	April 2	Nov. 8
South Dakota	Deadwood	May 11	May 31	Sept. 7
"	Huron	May 14	June 22	Sept. 3
"	Yankton	April 28	May 23	Sept. 13
Tennessee.	Chattanooga	Mar. 23	Ap il 24	Sept. 30
"	Knoxville	April 6	April 25	Oct. 8
"	Memphis	Mar. 24	April 21	Oct. 2
"	Nashville	Mar. 31	May 24	Oct. 8
Texas	Abilene	Mar. 14	Mar. 29	Oct. 21
"	Brownsville	Jan. 24	Mar. 1	Dec. 5
"	El Paso	Mar. 27	April 22	Oct. 24
"	Galveston	Feb. 2	Mar. 18	Nov. 18
"	Palestine	......	Mar. 30	Nov. 10
Virginia	Lynchburg	April 11	May 7	Oct. 3
"	Norfolk	Mar. 26	April 26	Oct. 10
Wisconsin	La Crosse	May 1	May 23	Sept. 21
"	Milwaukee	April 30	May 28	Sept. 17

NORMAL PRECIPITATION IN THE UNITED STATES. (In Inches.)

(U. S. Weather Bureau.)

Divisions.	Jan.	Feb	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
New England States	4.16	3.90	4.71	3.26	3.39	3.11	3.70	4.24	3.49	4.90	4.03	3.55	36.44
Middle Atlantic States	3.68	3.33	3.93	3.52	3.69	3.95	4.72	4.83	4.08	3.35	3.29	3.31	45.68
South Atlantic States	4.21	3.73	4.63	3.73	4.19	5.26	6.25	6.60	5.39	4.19	3.13	3.83	55.14
Florida Peninsula	2.92	2.84	2.21	2.04	4.88	6.06	6.89	6.03	7.25	4.84	2.67	2.14	50.77
East Gulf States	6.10	4.78	5.88	4.50	4.33	5.17	6.15	5.52	4.65	2.88	4.03	4.56	58.55
West Gulf States	3.70	3.65	3.35	4.01	4.50	4.85	4.09	3.59	4.73	3.37	4.11	3.48	47.43
Ohio Valley and Tennessee	4.51	4.22	4.49	3.97	3.89	4.33	4.07	3.85	3.07	2.98	3.74	3.51	46.63
Lower Lake Region	2.72	2.72	2.64	2.39	3.23	3.71	2.36	3.02	3.08	3.25	3.18	2.89	35.13
Upper Lake Region	2.08	1.99	2.14	2.33	3.26	3.71	3.19	3.14	3.56	2.28	2.45	2.25	33.38
North Dakota	.63	.61	.74	1.66	2.30	3.56	2.86	2.18	1.71	1.54	.55	.74	19.08
Upper Mississippi Valley	1.81	2.02	2.20	2.91	4.09	4.78	3.72	3.25	3.43	2.90	2.16	2.03	35.30
Missouri Valley	1.12	1.47	1.84	3.19	4.54	4.66	4.08	3.61	2.72	2.15	1.68	1.16	32.22
Northern Slope	.64	.49	.66	1.53	2.41	2.55	1.78	1.37	.90	.78	.49	.57	14.17
Middle Slope	.79	.74	1.37	2.32	3.41	2.98	2.61	2.96	1.56	1.34	.78	.98	21.84
Southern Slope	...	...	...	...	...	...	...	...	...	...	...	...	...
Southern Plateau	.66	.85	.45	.30	.32	.50	1.72	1.68	.82	.80	.57	.90	9.57
Middle Plateau	1.49	1.34	1.36	1.33	1.25	.67	.22	.35	.60	.83	1.41	1.86	12.71
Northern Plateau	2.44	2.00	1.58	1.44	1.44	1.46	.50	.29	.76	1.52	1.26	2.19	16.88
N. Pac. Coast Region	10.98	7.10	5.58	3.86	2.76	2.55	1.12	1.28	2.86	6.27	7.63	10.06	62.05
Middle Pac. Coast Region	5.70	4.39	4.12	2.57	1.59	.62	.17	.02	.40	1.85	2.73	5.75	29.91
South Pac. Coast Region	2.07	2.30	1.85	1.32	.20	.10	tr.	.10	.13	.62	1.13	2.81	12.63

METEOROLOGICAL DATA FOR CANADA.

Province or City.	Normal Mean Temperature of the Air.		
	Monthly Temperature.		Mean for the Year.
	Lowest.	Highest.	
Ontario	19.3° F.	69.8° F.	43.8° F.
Quebec	13.5	70.2	42.6
New Brunswick	16.1	62.8	39.9
Nova Scotia	21.2	63.3	41.7
Prince Edward Island	14.7	64.3	40.5
Manitoba	0.6	65.9	32.6
British Columbia	22.8	72.2	48.1
Toronto	22.9	67.4	44.1
Montreal	16.8	72.2	44.3
St. John, N. B.	18.4	59.7	40.3
Halifax, N. S.	22.9	63.5	43.1

Normal rainfall in inches per year: Toronto 29.42, Windsor 23.78, Peterborough 20.55, Montreal 27.26, Quebec 19.26, St. John 33.27, Halifax 43.08, Glace Bay 55 49, Sydney 49.42, Winnipeg 16.83, Spence's Bridge 3.88.

COMPARISON OF LEADING INDUSTRIES IN THE UNITED STATES. (U. S. Census of 1890. in Round Numbers.)

	Capital Involved.	Employees.	Wages.	Raw Materials.	Products.
	Millions.	Thousands.	Millions.	Millions.	Millions.
Agriculture	15,982	8,286	....	....	2,460
Forest products, total	....	. ..	....	....	1,044
Forest industries, enumerated	562	348	102	245	446
Forest products, not enumerated (estimated)	....	....	....	....	598
Manufactures using wood	543	513	294	442	907
Mineral products, total	....	....	....	....	610
Coal	343	300	109	....	160
Gold and silver	486	57	40	....	99
Iron and steel	414	176	96	327	479
Manufactures of iron and steel	86	60	32	79	131
Leather	102	48	25	136	178
Leather manufactures	118	186	88	153	289
Woolen "	297	219	77	203	338
Cotton "	354	222	70	155	268

AREAS OF APPROPRIATED, VACANT, AND RESERVED LANDS IN THE UNITED STATES, 1898.

(U. S. Dept. Agr.)

States and Territories.	Total Area.	Unap-prop. and Un-reserved.	Reserved	Total Govern-ment Land.	Appropri-ated.
	acres.	per cent.	per cent.	per cent.	per cent.
Alabama	32,658,000	1.60	.26	1.86	98.14
Arizona	72,792,500	71.07	21.12	92.16	7.81
Arkansas	33,543,500	11.02	.01	11.03	88.97
California	99,361,083	42.72	16.35	59.07	40.93
Colorado	66,390,650	59.81	9.38	69.19	30.81
Florida	35,264,500	4.98	.06	5.04	94.96
Idaho	52,830,200	83.68	3.67	87.35	12.65
Indian Territory	19,575,040	....	100.00	100.00	....
Kansas	52,383,000	2.02	1.89	3.91	96.09
Louisiana	28,863,188	2.62	5.11	7.73	92.27
Michigan	36,819,000	1.37	.24	1.61	98.39
Minnesota	51,689,444	11.07	9.64	20.71	79.29
Mississippi	29,685,000	1.29	....	1.29	98.71
Missouri	43,796,000	1.02	... .	1.02	98.98
Montana	95,259,720	75.13	12.03	87.16	12.84
Nebraska	49,137,339	21.47	.14	21.61	78.39
Nevada	70,336,500	87.33	8.51	95.74	4.26
New Mexico	78,197,005	69.76	10.69	80.45	19.55
North Dakota	44,902,987	45.82	6.79	52.61	47.39
Oklahoma	24,753,663	28.31	29.11	57.42	42.58
Oregon	61,626,218	58.25	8.87	67.12	32.88
South Dakota	48,158,555	26.55	23.09	49.64	50.36
Utah	52,580,000	83.43	10.37	93.80	6.20
Washington	42,684,084	31.49	26.08	57.57	42.43
Wisconsin	35,275,000	1.17	1.04	2.21	97.79
Wyoming	62,433,000	78.54	13.16	91.70	8.30
Other States	579,024,029	....	.04	.04	99.96
Total	1,900,019,201	30.21	7.64	37.85	62.15

FARMING POPULATION OF THE UNITED STATES, 1880, 1890, AND 1900.

	Tenth Census.	Eleventh Census.	Twelfth Census.
Total population	50,152,866	62,622,250	75,994,575
Total engaged in agriculture	7,713,875	8,565,926	10,381,765
Professional service	603,202	944,333	1,258,739
Domestic and personal service	3,423,815	4,220,812	5,580,657
Trade and transportation	1,866,481	3,326,122	4,766,964
Mfg. and mechan. pursuits	3,784,726	5,678,468	7,085,992
All occupations	17,392,099	22,735,661	29,074,117
Engaged in agriculture, per cent	44.3	37.7	35.7

NUMBER AND CLASSIFICATION OF THE AGRICULTURAL POPULATION, 10 YEARS OF AGE AND OVER.

(Twelfth Census.)

Occupation.	Male.	Female.	Total.
Agricultural laborers	3,747,668	663,209	4,410,877
Dairymen and dairywomen	9,983	892	10,875
Farmers, planters, and overseers	5,367,169	307,706	5,674,875
Gardeners, florists, nurserymen, etc	58,928	2,860	61,788
Lumbermen and raftsmen	71,920	100	72,020
Stock-raisers, herders, and drovers	83,056	1,932	84,988
Turpentine farmers and laborers	24,456	281	24,737
Wood-choppers	35,962	113	36,075
Other agricultural pursuits	5,287	243	5,53c
Total engaged in agriculture	0,404,429	977,336	10 381,765

NUMBER OF FARMS IN THE UNITED STATES AND THEIR VALUE.

(Thirteenth Census.)

States.	No. of Farms.	Value.	States.	No. of Farms.	Value.
Alabama	262,901	$370,138,429	Nebraska	129,678	2,079,818,647
Arizona	9,227	75,123,970	Nevada	2,689	60,399,365
Arkansas	214,678	400,089,303	N. Hamp.	27,053	103,704,196
California	88,197	1,614,694,584	N. Jersey	33,487	254,832,665
Colorado	46,170	491,471,806	N. Mexico	35,676	159,399,771
Conn.	26,815	159,399,771	N. York	215,597	1,451,481,495
Delaware	10,836	63,179,201	N. Carolina	253,725	537,716,210
D. of Col.	217	8,476,533	N. Dakota	74,360	974,814,205
Florida	50,016	143,183,183	Ohio	272,045	1,902,694,589
Georgia	291,027	580,546,381	Oklahoma	190,192	918,198,882
Idaho	30,807	305,317,185	Oregon	45,502	528,243,782
Illinois	251,872	3,905,321,075	Penna.	219,295	1,253,274,862
Indiana	215,485	1,809,135,238	Rhode I.	5,292	32,990,739
Iowa	217,044	3,745,860,544	S. Carolina	176,434	392,128,314
Kansas	177,841	2,039,389,910	S. Dakota	177,841	1,166,096,980
Kentucky	259,185	773,797,880	Tenn.	259,815	612,520,836
Louisiana	120,546	301,220,988	Texas	120,546	2,218,645,164
Maine	60,016	199,271,998	Utah	21,676	150,795,201
Maryland	48,923	286,167,028	Vermont	32,709	145,399,728
Mass.	36,917	226,474,025	Virginia	184,018	625,065,383
Michigan	206,960	1,088,858,379	Wash.	56,192	637,543,411
Minn.	156,137	1,476,411,737	W. Va.	96,685	314,738,540
Miss.	274,382	426,314,634	Wisconsin	177,127	1,413,118,785
Missouri	277,244	2,052,917,488	Wyoming	10,987	167,189,081
Montana	26,214	347,828,770	Total	6,361,502	40,991,449,090

STATISTICS CONCERNING FARMS IN THE UNITED STATES.

(Twe fth Census.)

	United States.	North Atlantic Division.	South Atlantic Division.	North Central Division.	South Central Division.	Western Division.
Number of farms, 1900	5,737,372	677,506	962,225	2,196,567	1,658,166	242,908
Total area of farms, acres	838,591,774	65,409,089	104,297,506	317,349,474	257,738,845	93,796,860
Average number of acres per farm	146.2	96.5	108.4	144.5	155.4	386.1
Improved land in farms, acres	414,498,487	38,920,614	46,100,226	222,314,099	80,007,867	27,155,681
" " " " , per cent	49.4	59.5	44.2	70.1	31.0	29.0
Total value of farm property, 1900, dols.	20,439,901,164	2,950,532,628	1,454,031,316	11,504,919,848	2,815,823,403	1,714,593,969
Value of farm products, 1899, dollars	4,717,069,973	666,347,164	465,492,097	2,360,011,670	888,572,699	336,6[illegible]6,343
Number of farms under 20 acres	673,870	103,183	147,165	147,721	238,257	37,544
" " " 20 and under 50 acres	1,257,496	118,135	265,623	341,120	498,491	34,118
" " " 50 " " 100 "	1,366,038	191,730	216,522	562,891	366,525	28,370
" " " 100 " " 175 "	1,422,262	177,540	181,290	656,423	337,546	69,463
" " " 175 " " 500 "	868,020	81,822	128,541	435,088	175,445	47,124
" " " 500 acres and over	149,686	5,096	23,084	53,315	41,902	26,289
Farms operated by owners, per cent	64.7	79.2	55.7	72.1	51.4	83.4
" " " cash tenants, per ct.	13.1	9.8	18.0	9.5	17.3	7.7
" " " share tenants, pr. ct.	22.2	11.0	26.3	18.4	31.3	8.9
Average value per acre of products, dols.	4.46	7.56	3.87	5.64	2.96	3.08
Av. expenditures per farm, 1899, labor	$62	$105	$39	$65	$30	$232
" " " " " fertil's	$9	$23	$24	$3	$4	$4

NOTE.—*North Atlantic Division:* Me., N. H., Vt., Mass., R. I., Conn., N. Y., N. J., Penn. *South Atlantic Div.:* Del. Md., D. C., Va., W. Va., N. C., S. C., Ga., Fla. *North Central Div.:* O., Ind., Ill., Mich., Wis., Minn., Ia., Mo., N. D., S. D., Neb., Kan. *South Central Div.:* Ky., Tenn., Ala., Miss., La., Ark., I. T., Okla., Tex. *Western Div.:* Mont., Idaho, Wyo., Colo., N. M., Ariz., Utah, Nev., Wash., Ore., Cal.

STATISTICS OF THE PRINCIPAL CROPS OF THE UNITED STATES, 1912.

(U. S. Dept. of Agriculture.)

State or Territory.	Indian Corn.			Wheat.			Oats.		
	Acres.*	Bushels.*	Value, Dollars.*	Acres.*	Bushels.*	Value, Dollars.*	Acres.*	Bushels.*	Value, Dollars.*
Maine	16	640	480	3	70	72	133	4,602	2,347
New Hampshire	23	1,058	794	....	....	....	12	468	225
Vermont	45	1,800	1,296	1	25	24	77	3,311	1,589
Massachusetts	47	2,115	1,629	....	....	....	8	272	128
Rhode Island	11	456	401	....	....	....	2	57	26
Connecticut	60	3,000	2,310	....	....	....	11	338	166
New York	512	19,763	13,834	335	5,360	5,306	1,192	36,714	15,420
New Jersey	273	10,374	7,054	79	1,462	1,433	67	1,849	814
Pennsylvania	1449	61,582	38,797	1,240	22,320	21,204	1,099	36,377	14,915
Delaware	195	6,630	3,381	111	1,942	1,864	4	122	55
Maryland	670	24,455	13,450	599	8,985	8,536	45	1,350	608
Virginia	1,980	47,520	33,739	741	8,596	8,682	175	3,885	2,020
North Carolina	2,808	51,106	42,418	598	5,322	5,907	204	3,794	2,352
South Carolina	1,915	34,278	29,136	79	727	865	324	6,966	4,598
Georgia	3,910	53,958	45,864	132	1,228	1,498	364	7,571	4,921
Florida	655	8,515	6,727	....	....	....	43	740	518
Alabama	3,150	54,180	42,802	30	318	359	260	5,200	3,224
Mississippi	3,106	56,840	40,356	8	96	93	113	1,966	1,180
Louisiana	1,805	32,490	22,093	....	....	....	34	707	361
Texas	7,300	153,300	98,112	735	11,025	10,253	865	31,140	13,390
Arkansas	2,475	50,490	33,828	94	940	884	175	3,482	1,741
Tennessee	3,332	88,298	53,862	674	7,077	7,077	258	5,599	2,632
West Virginia	725	24,505	15,928	233	3,378	3,412	111	3,108	1,461
Kentucky	3,600	109,440	60,192	686	6,860	6,791	150	4,035	1,775

Ohio	4,075	174,410	78,484	1,220	9,760	9,565	2,120	93,280	30,782
Michigan	1,625	55,250	31,492	700	7,000	6,720	1,485	51,826	17,103
Indiana	4,947	199,364	83,733	1,260	10,080	9,374	1,990	79,799	23,940
Illinois	10,658	426,320	174,791	1,183	9,819	8,641	4,220	182,726	54,818
Wisconsin	1,632	58,262	29,714	188	3,564	2,958	2,272	84,746	27,119
Minnesota	2,266	78,177	28,925	4,325	67,038	48,938	2,948	122,932	31,962
Iowa	10,047	432,021	151,207	650	12,850	10,023	4,928	217,818	58,811
Missouri	7,622	243,904	112,196	1,900	23,750	21,375	1,125	37,125	12,994
Kansas	7,575	174,225	69,690	5,956	92,290	68,295	1,720	55,040	19,264
Nebraska	7,609	182,616	67,568	3,123	55,052	37,985	2,275	55,510	16,653
South Dakota	2,495	76,347	28,248	3,675	52,185	36,008	1,550	52,390	13,098
North Dakota	328	8,758	3,766	7,990	143,820	99,236	2,300	95,220	20,948
Montana	24	612	428	803	19,346	12,381	476	22,848	7,997
Wyoming	16	368	236	76	2,181	1,745	205	8,569	3,171
Colorado	420	8,736	4,368	453	10,968	8,006	290	12,412	4,717
New Mexico	93	2,083	1,562	59	1,232	1,109	53	1,839	828
Arizona	16	528	528	23	707	778	6	268	188
Utah	9	270	202	236	6,059	4,544	91	4,222	2,069
Nevada	1	30	29	39	1,137	1,137	10	400	208
Idaho	12	394	276	510	14,566	9,613	348	17,017	5,956
Washington	31	846	651	2,285	53,728	36,535	284	13,689	5,476
Oregon	20	630	472	842	21,018	15,132	359	13,714	5,623
California	52	1,924	1,635	370	6,290	5,850	200	7,800	4,290
Oklahoma	5,448	101,878	41,770	1,570	20,096	15,072	936	23,494	7,988
United States	107,803	3,124,746	1,520,454	45,814	730,267	555,280	37,917	1,418,337	452,469

* Expressed in thousands; 000 omitted.

STATISTICS OF THE PRINCIPAL CROPS IN THE UNITED STATES, 1912.

(Continued.)

State or Territory.	Barley Acres.*	Barley Bushels.*	Barley Value, Dollars.*	Potatoes. Acres.*	Potatoes. Bushels.*	Potatoes. Value, Dollars.*	Hay. Acres.*	Hay. Tons.*	Hay. Value, Dollars.*
Maine	4	105	81	117	23,166	12,741	1,231	1,428	19,564
New Hampshire	1	28	24	17	2,380	1,452	501	626	9,390
Vermont	13	455	364	26	3,640	2,002	1,010	1,515	21,210
Massachusetts	....	....	....	26	3,380	2,535	477	596	12,814
Rhode Island	....	....	....	5	565	435	58	66	1,465
Connecticut	....	....	....	23	2,461	1,920	379	436	9,810
New York	82	2,132	1,450	360	38,160	22,133	4,720	5,900	87,910
New Jersey	....	....	....	92	9,936	6,558	362	521	10,420
Pennsylvania	7	192	131	265	28,885	16,464	3,173	4,537	70,777
Delaware	....	....	....	11	1,100	770	72	96	1,440
Maryland	4	108	73	37	4,144	2,404	381	575	8,280
Virginia	10	250	188	95	8,265	5,372	741	889	13,513
North Carolina	....	....	....	30	2,550	1,938	293	381	6,363
South Carolina	....	....	....	10	900	1,008	194	223	4,014
Georgia	....	....	....	12	936	814	234	316	5,372
Florida	....	....	....	11	1,023	1,125	43	54	977
Alabama	....	....	....	15	1,215	1,094	209	261	3,811
Mississippi	....	....	....	10	890	801	201	297	3,712
Louisiana	....	....	....	20	1,460	1,212	142	234	2,972
Texas	6	176	137	52	3,276	3,440	387	542	5,637
Arkansas	....	....	....	25	1,750	1,610	286	352	4,224
Tennessee	2	52	42	38	3,344	2,341	888	1,154	18,233
West Virginia	....	....	....	47	5,264	3,264	745	1,028	15,420
Kentucky	3	78	58	51	5,151	3,451	815	1,002	13,727

Ohio	20	620	341	186	20,832	11,041	2,960	4,026	52,338
Michigan	87	2,262	1,470	350	36,750	15,068	2,395	3,186	40,450
Indiana	9	266	160	87	9,918	4,959	1,885	2,582	29,435
Illinois	57	1,796	952	137	13,837	8,302	2,512	3,266	41,152
Wisconsin	845	24,843	13,664	291	34,920	11,873	2,250	3,600	43,560
Minnesota	1,490	42,018	17,227	245	33,075	9,261	1,661	2,541	16,262
Iowa	470	14,570	7,576	174	18,966	8,724	3,537	4,952	47,044
Missouri	6	149	98	95	7,980	5,506	3,187	4,143	40,601
Kansas	176	4,136	1,654	70	5,740	4,190	1,627	2,440	18,544
Nebraska	113	2,486	1,044	118	9,440	4,814	1,150	1,552	13,037
South Dakota	887	23,062	9,686	62	6,510	2,344	460	672	4,099
North Dakota	1,176	35,162	12,307	52	6,656	1,864	364	510	2,805
Montana	39	1,424	755	37	6,105	2,442	460	1,216	10,093
Wyoming	11	374	232	11	1,540	924	452	859	7,387
Colorado	76	2,964	1,482	85	8,075	3,311	870	1,905	16,574
New Mexico	2	70	50	9	900	585	187	436	3,706
Arizona	36	1,440	1,253	1	125	156	113	384	4,608
Utah	25	1,125	664	19	3,515	1,722	368	1,023	8,184
Nevada	12	492	428	12	2,136	1,282	227	681	5,925
Idaho	159	6,916	3,527	35	6,475	1,878	692	1,938	12,209
Washington	183	7,869	4,147	68	11,356	4,088	776	1,707	17,241
Oregon	119	4,284	2,356	65	10,075	3,123	790	1,738	14,425
California	1,392	41,760	29,232	78	10,140	6,591	2,500	3,825	52,402
Oklahoma	8	160	80	29	1,740	1,618	385	481	3,559
United States	7,530	223,824	112,957	3,711	420,647	212,550	40,530	72,691	856,695

*Expressed in thousands; 000 omitted.

AVERAGE AGRICULTURAL WAGES IN THE U. S. IN 1893–1895, INCLUSIVE. (U. S. Dept. of Agriculture.)

Years.	Per Month for Season or Year.		Per Day in Harvest.		Per Day other than Harvest.	
	With Board.	Without Board.	With Board.	Without Board.	With Board.	Without Board.
1893.......	$13.29	$19.10	$1.03	$1.24	$0.69	$0.89
1894.......	12.16	17.74	.93	1.13	.63	.81
1895.......	12.02	17.69	.92	1.14	.62	.81

INDUSTRY GROUPS IN THE UNITED STATES.

(Twelfth Census.)

	Number of Establishments.	Capital.	Av. Number of Wage Earners.	Rank.
Food and kindred prod'cts	61,266	$937,686,610	311,717	7
Textiles...............	30,048	1,366,604,058	1,029,910	1
Iron and steel and their products............	13,896	1,528,979,076	733,968	2
Lumber and its manuf'res.	47,054	945,934,565	546,872	4
Leather and its finished products............	16,989	343,600,513	238,202	10
Paper and printing......	26,747	557,610,887	297,551	8
Liquors and beverages...	7,861	534,101,049	63,072	14
Chemicals and allied pr'cts	5,443	498,282,219	101,480	13
Clay, glass, and stone pr'ts	14,809	350,902,367	244,987	9
Metals and metal prod'cts other than iron and steel	16,305	410,646,057	190,757	11
Tobacco...............	15,252	124,089,871	142,277	12
Vehicles for land transportation...............	10,112	396,671,441	316,157	6
Shipbuilding...........	1,116	77,362,701	46,781	15
Miscellaneous industries .	29,479	1,348,920,721	483,273	5
Hand trades...........	215,814	392,442,255	559,130	3

	Wages.	Value of Products.		Rank.
		Gross.	Net.	
Food and kindred prod'cts	$128,667,428	2,273,880,874	1,750,811,817	1
Textiles...............	341,734,399	1,637,484,484	1,081,961,248	2
Iron and steel and their products............	381,875,409	1,793,490,908	983,821,918	3
Lumber and its manuf'res.	212,124,780	1,030,695,350	547,227,860	6
Leather and its finished products............	99,759,885	583,731,046	329,614,996	11
Paper and printing......	140,092,453	606,317,768	419,798,101	7
Liquors and beverages...	36,946,557	425,504,167	349,157,618	10
Chemicals and allied pr'ts.	43,850,282	552,797,877	372,538,857	8
Clay, glass, and stone pr'ts	109,022,582	293,564,235	245,447,118	14
Metals and metal products other than iron and steel	96,749,051	748,795,464	371,154,446	9
Tobacco...............	49,852,484	283,076,546	264,052,573	12
Vehicles for land transportation...............	164,559,022	508,524,510	250,622,377	13
Shipbuilding...........	24,839,163	74,578,158	42,492,518	15
Miscellaneous industries..	202,746,162	1,004,002,294	638,101,538	5
Hand trades...........	288,118,421	1,183,615,478	7[illegible]1,104,850	4

AREA, PRODUCTION, AND VALUE OF PRINCIPAL CROPS IN THE UNITED STATES, 1912

(U. S. Dept. of Agriculture.)

Crop.		Total Production.*	Total Area, Acres.*	Total Value, Dollars.*	Ave. Yield per Acre.	Ave. Farm Price per Unit. Cents.	Ave. Value per Acre, Dollars.
Indian corn..	bu.	3,124,746	107,083	1,520,454	29.2	48.7	14.22
Wheat,	"	730,267	45,814	555,280	15.9	76.0	12.08
Oats,	"	1,418,337	37,917	452,469	37.4	31.9	11.93
Barley,	"	223,824	7,530	112,957	29.7	50.4	14.97
Rye,	"	35,664	2,117	23,636	16.8	66.3	11.14
Buckwheat	"	19,249	841	12,720	22.9	66.1	15.14
Potatoes,	"	420,647	3,711	212,550	113.4	50.5	57.27
Hay,	tons	72,691	49,530	856,695	1.47	11.79†	17.33
Cotton ‡	bales	15,693	36,045	732,420	207.7	8.8	18.28
Tobacco,	lbs.	962,855	1,226	104,063	785.5	10.8	84.83
Flaxseed	bu.	28,073	2,851	32,202	9.8	114.7	11.24
Rice,	"	25,054	723	23,423	34.7	93.5	32.44
Hops ‡,	lbs.	51,672	....	....	....	....	....

* Expressed in thousands; 000 omitted.
† Dollars.
‡ Data for 1911.

THE PRINCIPAL CEREAL PRODUCTS OF THE UNITED STATES.

As Shown by the Census Returns, from 1850 to 1910.

Census	Indian Corn.	Wheat.	Oats.	Barley.	Rye.	Buckwheat.
	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.
1850	592,071,104	100,485,944	146,584,179	5,167,015	14,188,813	8,956,912
1860	838,792,742	173,104,924	172,643,185	15,825,898	21,101,380	17,571,818
1870	760,944,549	287,745,626	282,107,157	29,761,305	16,918,795	9,821,721
1880	1,754,861,525	459,479,505	407,858,999	44,113,495	19,831,595	11,817,327
1890	2,112,327,547	468,373,968	809,250,666	78,332,976	28,421,398	12,110,349
1900	2,666,324,370	658,534,252	943,389,375	119,634,877	25,568,625	11,233,515
1910	2,552,189,630	683,379,259	1,007,142,980	173,344,212	29,520,457	14,849,332

PRODUCTION OF VARIOUS CROPS IN CANADA, 1912.

Crops.		Total Yields.	Crops.		Total Yields.
Wheat.........	bu.	199,236,000	Flaxseed................	bu.	21,681,500
Barley........	"	44,014,000	Corn (maize)............	"	16,569,800
Oats..........	"	361,733,000	Potatoes................	"	81,343,000
Rye...........	"	2,594,000	Turnips and other roots..	"	87,505,000
Peas..........	"	3,773,500	Hay and clover,.........	tons	11,189,000
Beans.........	"	1,040,800	Fodder corn............	"	2,858,900
Buckwheat....	"	10,193,000	Sugar beets............	"	204,000
Mixed grains...	"	17,952,000	Alfalfa................	"	310,100

AVERAGE COST PER ACRE OF RAISING WHEAT, CORN, AND COTTON IN THE UNITED STATES, 1893.*

(U. S. Dept. of Agriculture.)

	Wheat.	Corn.	Cotton, Upland.	Cotton, Seab'd.
Rent of land	$2.81	$3.03	$2.88	$2.36
Manure or fertilizers	2.16	1.86	1.46	3.75
Preparing ground	1.87	1.62	2.81	3.65
Seed	.96	....	.21	.38
Sowing or planting	.37	.42	.28	.46
Cultivating	....	1.80	1.31	1.73
Harvesting, gathering, or picking	1.19	1.22	3.37	5.17
Thrashing	1.20	....	....	....
Ginning and pressing	..	....	1.65	2.61
Housing	.37	.50	....	....
Repairing implements	...	....	.42	.42
Marketing	.76	1.26	.64	.91
Other expenses	....	....	.41	.51
Total	$11.69	$11.71	$15.42	$21.95

AVERAGE FARM PRICE OF VARIOUS AGRICULTURAL PRODUCTS ON DEC. 1 IN EACH YEAR FROM 1890 TO 1910.

(U. S. Dept. of Agriculture.)

Crop.	1890	1895	1900	1905	1910
	$	$	$	$	$
Corn per bushel	0.506	0.253	0.357	0.288	0.480
Wheat "	.838	.509	.619	.748	.883
Rye "	.629	.440	.512	.611	.715
Oats "	.424	.199	.258	.291	.344
Barley "	.648	.337	.408	.403	.578
Buckwheat "	.577	.452	.558	.587	.661
Irish pota's "	.777	.266	.431	.617	.557
Hay per ton	7.74	8.35	8.89	8.52	12.26
Cotton per lb	.086	.076	....	.105	.142
Leaf tobacco, per lb	.077	.089	....	.085	.093

* Data for wheat and corn consolidated from returns from nearly 30,000 leading farmers scattered throughout the United States. The data for cotton were secured in 1897, and are the averages of returns from over 3400 planters.

NUMBER AND VALUE OF FARM ANIMALS IN THE UNITED STATES, 1880-1910. (U. S. Dept. of Agriculture.)

Farm Animals.	Jan. 1, 1880.	Jan. 1, 1890.	Jan. 1, 1900.	Jan. 1, 1910.
Horses, number	11,201,800	14,213,837	13,537,524	21,040,000
value..	$613,296,611	$978,516,562	$603,969,442	$2,276,363,000
Mules, number	1,729,500	2,332,027	2,086,027	4,123,000
value..	$105,948,319	$182,394,099	$111,717,092	$494,095,000
Milch cows, No.	12,027,000	15,952,883	16,292,360	21,801,000
value..	$279,899,420	$352,152,133	$514,812,106	$780,308,000
Other cat., No.	21,321,000	36,849,024	27,610,054	47,279,000
value..	$341,761,154	$560,625,137	$689,486,260	$917,453,000
Sheep, number	40,765,900	44,336,072	41,883,065	57,216,000
value..	$90,230,537	$100,659,761	$122,665,913	$233,664,000
Swine, number	34,034,100	51,602,780	37,079,000	47,782,000
value..	$145,781,515	$243,418,336	$85,472,321	$436,603,000
Total value of farm animals.	$1,576,917,556	$2,418,766,028	$2,228,123,134	$5,138,486,000

VALUES OF FARM PROPERTY AND PRODUCTS IN CANADA, 1901.

(Census of 1901.)

Farm property, 1901.		*Agricultural products*, 1901.	
Total value..........	$1,787,102,63c	Total value...........	$364,906,866
Land and buildings...	1,403,269,501	Field crops...........	194,953,420
Implements and machinery.........	108,665,502	Fruits and vegetables ..	12,994,900
Horses..............	118,279,418	Nursery stock sold in year..............	469,501
Milch cows..........	69,237,970	Live stock sold in year.	52,755,375
Other horned cattle...	54,197,341	Meats, etc., of animals slaughtered on farm.	22,951,527
Sheep...............	10,490,594	Dairy products........	66,470,953
Swine...............	16,445,702	Wool................	1,887,064
Poultry.............	5,723,890	Eggs.................	10,286,828
Bees................	792,711	Honey and wax.......	356,816
		Maple sugar..........	1,780,482

NUMBER OF FARM ANIMALS AND ANIMAL PRODUCTS IN CANADA, 1901.

(Census of 1901.)

Horses over 3 years old ..	1,304,910	Cattle, killed or sold....	1,110,209
Horses under 3 years old..	272,583	Sheep, killed or sold....	1,342,288
Milch cows.............	2,408,677	Swine, killed or sold....	2,555,413
Other horned cattle......	3,167,774	Poultry, killed or sold ..	7,063,597
Sheep..................	2,510,239	Butter, home made, lbs.	105,343,076
Swine..................	17,922,658	Wool, lbs.............	10 657,597
Poultry................	189,986	Honey, lbs............	3,569,567
Hives of bees..........	2,353,828	Eggs, doz............	84,132,802

BREEDS AND NUMBER OF REGISTERED LIVE STOCK IN THE UNITED STATES, DEC. 31, 1905.

(U. S. Dept. of Agriculture.)

Breed.	Number Male.	Registered Female.	Number Living. Male.	Number Living. Female.
Cattle: Aberdeen-Angus	38,188	48,604	27,496	34,994
Ayrshire	9,689	20,883	*	*
Devon	8,084	13,717	3,500	10,000
Dutch-belted	573	1,265	*	*
Galloway	16,620	11,080	8,370	6,480
Guernsey	10,683	19,889	6,000	12 000
Hereford	112,780	115,620	45,000	60,000
Holstein-Friesian	46,031	95,037	14,199	31,756
Jersey	71,907	193,978	*	*
Polled Durham	5,403	6,460	3,935	4,845
Red Polled	14,601	25,006	5,500	10,500
Shorthorn	249,800	391,600	87,430	176,220
Sussex	78	185	50	100
Swiss, Brown	2,159	3,150	300	1,500
Horses: Cleveland Bay	1,236	502	1,050	400
Clydesdale	12,370		*	*
Coach, French	130	4	125	4
" German	1,656	246	1,500	225
" Oldenburg	260	23	190	14
Draft, Belgian	2,056	266	2,055	265
" French	9,000	5,000	*	*
Hackney†	726	1,542	684	1 416
Morgan †	5 021	2,880	3,765	2,100
Percheron	1,640	1,460	19,000	12,000
" (Ohio)	928	102	913	94
Saddle Horse, American	2,529	3,549	*	*
Shetland Pony	2,300	3,500	2,000	2,500
Shire	6,062	2,148	*	*
Suffolk	159	88	150	
Thoroughbred	45,309		*	*
Trotter, American	42,597	152,700 †	*	*
Jacks and Jennies	1,000	750	750	500
Sheep: Cheviot	10,700		575	2,650
Cotswold	36,610		14,000	
Dorset Horn	1,395	3,703	1,000	2,800
Hampshire Down	5,573	12,844	3,000	9,000
Leicester	3,538	5,437	2,972	4,567
Lincoln	5,754	8,246	4,100	5,900
Merino (Delaine, Ohio.)	9,401		6,900	
" (" ")	8,000	14,300	2,500	8,000
" (" Pa.)†	5,054	11,259	1,500	3,000
" (" ")	6,805	11,599	1,500	5,000
" (French)	34,075		*	*
" (German)	162	191	105	175
" (Spanish, Mich.)	12,550	37,700	400	4,300
" (" Ohio)	16,691	33,384	2,842	8,035
" (" N. Y.)	7,916	11,912	280	1,875
" (" ")	1,275	1,500	100	200
" (" Vt.)	217,850		*	*
Oxford Down	32,798 †		*	*

* No data. † Estimates for 1904.

BREEDS AND NUMBERS OF REGISTERED LIVE STOCK IN THE UNITED STATES—*Continued.*

Breed.	Number Male.	Registered Female.	Number Living. Male.	Number Living. Female.
Sheep (Continued).				
Shropshire	100,000	134,000	20,000	40.000
South Down	19,933		10,200	
Suffolk	1013		550	
Hogs: Berkshire	88.080		33,000	
Cheshire	1,225	2,115	275	575
Chester, White	5,665	8,912	600	2,000
" Ohio Impr.	3,403	9.000	1,800	6,200
Duroc Jersey (Ind.)	8,026	18,450	*	*
" " (Ill.)	21,800	55,000	30,000	
Hampshire (Thin Rind)	294	540	155	387
Poland China (Ill.)	52,331	130,620	27,000	68,000
" " (Ind.)	32 000	72,000	10,000	23,000
" " (Mo.)	39,008	93,234	2,000	18,000
" " (Tenn.)	691	1,030	400	600
Tamworth †	1,949		1,200	
Yorkshire	2,860	3,640	2,000	3,200

* No data. † Estimates for 1904.

PURE-BRED CATTLE OF BREEDS USED FOR DAIRYING. (U. S. Dept. of Agriculture.)

Estimates of numbers living in the United States, 1905, and values of same.

Breeds.	Number Registered.	Est. No. Living.	Av. Val. per Head†	Breeds.	Number Registered.	Est. No. Living.	Av. Val. per Head†
Ayrshire	30,572	*	$100	Jersey	265,885	*	$100
Brown-Swiss	5,309	1,800	75	Polled Durham	11,863	8,780	80
Devon	21,801	13,500	75	Red Polled	39,607	16,000	150
Dutch Belted	1,838	*	200	‡Shorthorn	641,400	263,650	170
Guernsey	30,572	18,000	140				
Holstein-Friesian	141,068	45,955	130				

* No data. † Figures published 1903. ‡ Chiefly beef stock.

DAIRY STATISTICS FOR THE UNITED STATES, 1900.

(Twelfth Census.)

States and Territories.	Dairy Cows, 2 Years and Over.	Value of Dairy Produce.	Milk Produced.	Butter Reported by		Cheese Reported by	
				Farms.	Factories.	Farms.	Factories.
	Number.	Dollars.	Gallons.	Pounds.	Pounds.	Pounds.	Pounds.
Alabama	279,263	6,610,967	95,882,103	19,121,964	17,357	36,374	10,000
Arizona	17,965	540,700	3,056,109	379,311	424,083	33,305	373,752
Arkansas	312,577	6,912,459	109,861,393	21,585,258	168,575	18,385	12,600
California	307,245	12,128,471	153,684,741	20,853,360	13,147,137	4,249,588	2,676,543
Colorado	100,116	3,778,901	38,440,111	4,932,482	1,566,639	103,184	1,465,257
Connecticut	126,434	7,090,188	68,951,862	4,591,780	3,888,405	40,623	321,263
Delaware	32,591	1,092,807	12,681,268	1,629,949	969,889	104	15,000
District of Columbia	1,251	186,096	850,349	3,478	......	......	......
Florida	78,830	1,468,603	9,640,434	1,386,445	......	3,751	......
Georgia	276,024	5,954,575	82,438,532	15,111,494	48,960	2,236	......
Idaho	51,929	1,243,197	15,122,948	2,520,316	432,570	196,952	194,380
Illinois	1,007,664	29,638,619	457,106,995	52,493,450	34,055,312	323,485	9,055,119
Indiana	574,276	15,739,594	263,457,239	51,042,396	3,553,483	178,733	1,260,168
Indian Territory	110,687	1,504,747	26,493,855	5,105,715	......	1,227	......
Iowa	1,423,648	27,516,870	535,872,240	61,789,288	77,233,264	306,428	4,242,637
Kansas	676,456	11,782,902	244,909,123	41,640,772	18,196,483	291,445	2,422,710
Kentucky	364,025	9,985,540	159,311,527	30,446,381	184,663	45,759	28,000
Louisiana	184,815	4,168,015	39,251,413	4,018,229	......	135,104	......
Maine	173,592	8,182,344	99,586,188	16,174,173	4,461,399	425,102	553,946
Maryland	147,284	5,228,698	64,040,517	9,096,662	2,541,716	338,453	......
Massachusetts	184,562	12,885,744	105,571,873	4,980,262	4,591,919	19,629	250,542
Michigan	563,905	16,903,087	309,617,046	60,051,998	7,820,712	331,176	10,422,582
Minnesota	753,632	16,623,460	304,017,106	41,188,846	41,174,469	290,623	3,285,019
Mississippi	299,318	6,064,513	97,030,385	18,881,236	48,525	28,572	......
Missouri	765,386	15,042,360	258,207,755	45,509,110	1,440,616	323,439	1,072,751
Montana	45,036	1,669,978	15,696,214	2,454,072	34,238	30,924	......

Nebraska	512,544	8,595,408	190,477,911	34,518,659	11,726,180	264,430	313,600
Nevada	13,606	433,391	4,446,071	569,523	623,402	94,082	80,150
New Hampshire	115,036	5,591,272	60,724,590	6,385,611	5,034,270	104,339	116,741
New Jersey	157,407	8,436,869	77,714,055	5,894,363	1,325,519	24,377	100,000
New Mexico	16,775	499,423	3,009,657	313,003	....	68,571	....
New York	1,501,608	55,474,155	772,799,352	74,714,376	40,693,846	2,624,552	,386,032
North Carolina	233,178	6,175,397	89,525,749	16,913,802	....	28,883	....
North Dakota	125,503	2,853,133	48,845,280	9,178,815	463,188	70,881	225,399
Ohio	818,239	25,383,627	425,870,394	79,551,299	8,087,631	1,167,001	18,156,527
Oklahoma	165,852	2,481,673	47,439,853	8,781,359	53,200	45,264	66,378
Oregon	122,447	3,550,953	48,582,968	8,107,450	1,975,357	467,256	1,195,564
Pennsylvania	943,773	35,860,110	487,033,818	74,221,085	37,137,161	857,167	10,267,443
Rhode Island	23,660	1,923,707	12,923,512	488,086	148,195	6,751	....
South Carolina	126,684	3,232,725	44,031,528	8,150,437	....	1,081	....
South Dakota	270,634	4,351,568	99,244,975	17,400,970	6,172,107	136,863	420,779
Tennessee	321,676	8,028,466	147,336,961	29,091,696	207,823	26,622	6,201
Texas	861,023	15,510,978	251,342,698	47,991,492	252,714	136,133	58,290
Utah	65,905	1,522,932	25,124,642	2,812,122	2,519,214	169,251	1,874,179
Vermont	270,194	9,321,389	142,042,223	18,834,706	22,453,381	406,659	4,713,105
Virginia	281,876	6,999,994	105,068,428	19,905,830	170,521	31,697	57,000
Washington	107,232	3,816,691	50,182,415	7,372,106	3,198,421	151,669	1,482,127
West Virginia	205,601	5,088,153	83,861,660	16,913,129	41,000	74,243	40,860
Wisconsin	998,397	26,779,721	472,274,264	44,739,147	61,813,502	1,635,618	77,748,680
Wyoming	18,272	421,613	5,121,974	888,554	29,500	24,327	1,000
Alaska	13	596	4,250	200	....	....	....
Hawaii	4,028	91,876	584,120	118,871	....	12	....
N. Atlantic Division	3,406,266	144,765,778	1,827,347,473	206,284,451	119,734,095	4,509,199	143,709,072
S. Atlantic Division	1,383,310	35,427,048	492,138,465	89,111,226	3,772,086	480,448	112,860
N. Central Division	8,400,384	201,210,349	3,609,900,328	539,104,750	271,736,947	5,320,122	128,625,971
S. Central Division	2,809,236	61,267,358	973,950,188	185,923,330	932,857	473,440	181,469
Western Division	866,528	29,606,250	362,467,850	51,202,299	23,950,561	5,589,109	9,342,952
United States	17,139,674	472,369,255	7,266,392,674	1,071,745,127	420,126,546	16,372,330	281,972,324

STATISTICS OF BUTTER, CHEESE, AND CONDENSED-MILK FACTORIES IN THE UNITED STATES.

(Twelfth Census.)

Totals for the United States.	1900. Butter and Cheese Factories.	1900. Urban Estabs.
Number of establishments reporting.	9,242	113
Capital employed, total. ... dollars	36,303,164	204,851
Land. ... "	1,818,519	29,875
Buildings. ... "	11,514,198	42,246
Machinery, tools, and implements. ... "	13,827,667	69,485
Cash and sundries. ... "	9,142,780	63,245
Employés. ... average number	12,799	66
Total wages paid. ... dollars	6,145,561	25,109
Materials used:		
Aggregate cost. ... dollars	108,841,200	310,005
For butter:		
Gathered cream. ... pounds	203,673,958	1,066,756
Milk. ... "	8,514,806,634	20,104,778
Total cost. ... dollars	73,489,355	250,670
For cheese:		
Milk. ... pounds	2,741,898,114	7,415,499
Cost. ... dollars	21,258,712	44,755
For condensed milk:		
Milk. ... pounds	421,378,073	....
Sugar. ... "	50,873,859	....
Total cost. ... dollars	7,252,124	....
Products:		
Aggregate value. ... dollars	130,783,349	415,928
Butter made:		
Packed solid. ... pounds	328,956,590	334,588
Prints or rolls. ... "	91,169,956	492,882
Total value. ... dollars	84,079,754	195,662
Cream sold. ... gallons	7,720,569	164,114
Value. ... dollars	4,435,444	112,092
Skim milk sold, fed, or returned to patrons. ... pounds	2,253,494,156	5,517,877
Value ... dollars	2,531,460	24,008
All other creamery products. ... "	1,023,402	583
Cheese, standard factory:		
Quantity. ... pounds	225,776,105	360,450
Value. ... dollars	21,363,477	36,050
Cheese, all other made:		
Quantity. ... pounds	56,196,219	301,714
Value. ... dollars	5,156,352	14,601
Whey sold. ... pounds	44,590,752	75,000
" otherwise used. ... "	164,476,195	....
Total value. ... dollars	204,277	75
All other cheese-factory products "	66,711	508
Condensed milk:		
Quantity. ... pounds	186,921,787	....
Value ... dollars	11,888,792	....

BUTTER AND CHEESE MAKING IN CANADA, 1901.

(Census of 1901.)

Number of factories..	3,576
Value of buildings and plant.........	$6,164,649
Persons employed...	6,886
Aggregate working days.............	1,140,702
Salaries and wages...	$1,464.110
Cream for butter, in. .	3,976,406
Cream for butter, lbs.	88,180,441
Milk for cheese, lbs. .	2,296,950,966
Cost of delivery to factory...........	$717,868
Patrons of butter factories..............	76,394
Patrons of cheese factories..............	124,726
Paid patrons for butter.	$6,036,699
" " " cheese.	$19,265,832
Butter made, lbs......	36,066,739
Cheese made, lbs......	220,833.269
Value of butter made..	$7,240,972
" " cheese " ..	$22,221,430
Total value of products.	$29,462,402

WOOL PRODUCT OF THE UNITED STATES, 1912.

	Total.
Number of sheep of shearing age, April 1, 1912..	38,481,000
Average weight of fleece, lbs..................	6.82
Shrinkage, per cent..........................	55.0
Wool, washed and unwashed, lbs...............	304,043,400
Wool, scoured, lbs...........................	136,866,652

PRODUCTION OF SUGAR IN THE UNITED STATES, 1870-1911.

Year.	Beet Sugar, Long Tons.	Cane Sugar, Long Tons.					Total.
		Louisiana.	Other South. States.	Porto Rico.	Hawaii.	Philippine Islands.	
1870–71	400	75,392	4,208	103,304	....	87,465	270,769
1880–81	500	121,867	5,500	61,715	41,870	205,508	436,960
1890–91	3,459	215,844	6,107	50,000	125,000	136,035	536,445
1900–01	76,859	275,579	2,891	72,800	321,461	55,244	804,834
1910–11	455,511	306,000	11,000	312,357	506,090	147,016	1,737,974

STATISTICS OF SUGAR-BEET FACTORIES IN THE UNITED STATES FOR 1912.

(U. S. Dept. of Agriculture.)

	Number of Factories.	Ave. Length of Campaign.	Sugar Made.	Area Harvested.	Ave. Yield per Acre.	Ave. Price per Ton.	Ave. Per cent Sucrose.	Ave. Purity Coefficient.
		Days	Short-tons.	Acres.	Sh'rt-tons.	Dollars.		Per cent.
California	11	90	158,904	111,416	9.01	5.46	18.79	84.0
Colorado	17	91	216,010	144,999	11.32	5.96	16.19	84.8
Michigan	16	74	95,049	124,241	6.75	5.69	14.72	83.8
Idaho and Utah	10	87	84,332	56,952	10.81	4.97	16.65	86.8
O., Ind., Ill., Wis.	11	87	57,921 *	53,986	9.90	5.60	14.43	82.3
Other States	8	88	80,340	63,706	9.25	5.81	16.61	84.1
United States	73	86	692,556	555,300	9.41	5.82	16.31	84.5

* Including estimates of one factory, based on acreage of beets.

PRODUCTION OF CANE- AND BEET-SUGAR, 1903-11.

	The World.		The United States.	
	Cane.	Beet.	Cane.	Beet.
	Tons.*	Tons.*	Tons.*	Tons.*
1903–1904	6,086,149	6,096,178	692,903	208,135
1904–1905	6,754,328	4,926,456	875,576	209,722
1905–1906	6,602,133	7,265,136	922,000	283,717
1906–1907	7,468,900	6,774,400	820,700	432,000
1907–1908	7,076,800	6,598,000	1,022,400	414,000
1908–1909	7,726,500	6,562,000	1,095,400	380,000
1909–1910	8,412,995	6,241,630	1,071,095	447,930
1910–1911	8,429,300	8,040,800	1,135,400	456,000

* Long tons, except in case of European beet-sugar production, which is given in metric tons (2204.6 lbs.).

MAPLE-SUGAR AND SIRUP, AND SORGHUM SIRUP PRODUCED IN THE UNITED STATES, 1899.

(Twelfth Census.)

	Sugar.	Sirup.	Value of Products.	
			Sugar.	Sirup.
	Pounds.	Gallons.	Dollars.	Dollars.
Maple	11,928,770	2,056,611	1,074,260	1,562,451
Sorghum	....	16,972,783	....	5,288,083

STATISTICS OF THE LUMBER INDUSTRY OF THE UNITED STATES, 1906. (U. S. DEPT. OF AGRICULTURE.)

Lumber.	Leading State.	Cut, M. Feet.	Per Cent.	Total Value.	Mill Value per M. Feet.
Yellow pine	La.	2,120,615	18.2	$31,919,636	$15.05
	U. S.	11,661,077	......	175,178,446	15.02
Douglas fir	Wash.	3,405,510	68.5	48,841,166	14.34
	U. S.	4,969,843	......	70,567,141	14.20
White pine	Minn.	1,664,734	36.2	29,072,499	17.46
	U. S.	4,583,727	......	83,952,701	18.32
Hemlock	Penna.	966,480	27.3	16,589,522	17.16
	U. S.	3,537,329	......	54,153,242	15.31
Oak	Ky.	339,829	12.0	6,667,701	19.62
	U. S.	2,820,393	......	61,377,266	21.76
Spruce	Me.	557,975	33.8	9,802,083	17.57
	U. S.	1,644,987	......	28,515,439	17.33
Western pine	Calif.	347,249	25.0	4,826,436	13.90
	U. S.	1,386,777	......	19,423,937	14.01
Maple	Mich.	492,845	55.8	7,096,204	14.40
	U. S.	882,878	......	13,714,083	15.53
Cypress	La.	573,096	68.3	12,849,911	22.42
	U. S.	839,276	......	18,403,392	21.94
Poplar	Ky.	160,123	23.4	3,732,465	23.31
	U. S.	683,132	......	16,538,260	24.21
Redwood	Calif.	659,678	100.0	10,978,759	16.64
Red gum	Ark.	140,819	31.0	1,774,394	12.60
	U. S.	453,678	......	6,102,886	13.46
Chestnut	Penna.	73,096	18.0	1,268,989	17.36
	U. S.	407,379	......	7,128,864	17.49
Basswood	Wisc.	162,155	43.0	2,890,178	17.82
	U. S.	376,838	......	7,029,950	18.66
Birch	Wisc.	151,063	40.8	2,334,163	15.45
	U. S.	370,432	......	6,384,705	17.24
Cedar	Wash.	236,648	66.2	4,415,054	18.66
	U. S.	357,845	......	6,484,600	18.12
Hickory	Ark.	23,364	15.8	902,201	38.62
	U. S.	148,212	......	4,508,583	30.42
Total hardwoods	U. S.	7,315,491	....	621,151,388	16.60
" softwoods	U. S.	30,235,245	....		

POULTRY AND EGG PRODUCTS IN THE UNITED STATES. (Tenth to Twelfth Censuses.)

	1879.	1889.	1899.
Production of eggs, dozen...	456,911,960	819,722,916	1,293,819,186
Price per dozen, cents......	....	....	11.1
Value of poultry..........	....	....	$136,891,877
" " eggs............	....	....	$144,286,158
Poultry on hand, June 1:			
Chickens*............	102,265,653	258,871,125	233,598,085
Turkeys............	....	10,754,060	6,599,367
Geese............	....	8,440,175	5,676,863
Ducks............	....	7,544,080	4,807,358
Total............	....	285,609,440	250,681,593

* Including Guinea fowls.

PRODUCTION OF HONEY AND BEESWAX IN THE UNITED STATES ACCORDING TO CENSUS RETURNS OF 1869, 1879, 1889, AND 1899.

	1869.	1879.	1889.	1899.
Honey, lbs........	14,702,815	25,741,485	63,894,186	61,196,160
Beeswax, lbs......	631,129	1,105,556	1,166,543	1,765,315

BEES, HONEY, AND WAX PRODUCED IN THE UNITED STATES.

(Twelfth Census.)

Swarms of bees, June 1, 1900..........................	4,109,625
Value of bees..	$10,186,513
Pounds of honey produced in 1899......................	61,196,160
" " wax " " "......................	1,765,315
Value of honey and wax produced in 1899................	$6 664,904

IMPORTS AND EXPORTS OF AGRICULTURAL PRODUCTS, 1911-1912.

(U. S. Dept. of Agriculture.)

	Imports.		Exports.	
	Quantity.	Value.	Quantity.	Value.
A. ANIMAL MATTER.				
Animals, Live.		Dollars.		Dollars.
Cattle	318,372	4,805,574	105,506	8,870,075
Horses	6,607	1,923,025	34,828	4,764,815
Mules	....	....	4,901	732,095
Sheep	23,588	157,257	157,263	626,985
Hogs	....	....	19,038	159,370
Others, including fowls	....	694,699	....	294,647
Total	....	7,580,555	....	15,447,987
Beeswax ... pounds	1,076,741	328,752	109,478	32,556
Dairy Products.				
Butter ... pounds	1,025,668	237,154	6,092,235	1,468,432
Cheese ... "	46,542,007	8,807,249	6,337,559	898,035
Cream ... gallons	1,120,427	923,779	....	....
Milk ... "	....	61,671	....	1,896,792
Total	....	10,029,853	....	4,263,259
Eggs ... dozens	973,053	147,173	15,405,609	3,395,952
Egg yolks ... pounds	43,822	4,430	....	29,541
Feathers and downs, crude	....	5,035,341	....	369,693

IMPORTS AND EXPORTS OF AGRICULTURAL PRODUCTS, 1911-1912.

(Continued.)

	Imports.		Exports.	
	Quantity.	Value.	Quantity.	Value.
A. ANIMAL MATTER—*Continued.*				
Fibers, Animal.		Dollars.		Dollars.
Silk....pounds	26,584,962	69,541,672	71,132	16,080
Wool, etc.... "	193,400,713	33,078,342	*	*
Total....	219,985,675	102,620,014	71,132	16,080
Gelatin....pounds	783,668	181,461	....	....
Glue.... "	7,534,322	776,696	3,059,952	314,909
Honey....gallons	115,040	62,684	....	212,652
Packing-house Products.				
Bones, hoofs, horns, etc....	....	1,038,653	....	162,009
Bristles....pounds	3,461,975	3,047,027	....	*
Grease, and all soap stock....	....	963,205	....	4,486,329
Hair....pounds	16,176,983	1,025,421	....	1,426,111
Hide cuttings and other glue stock....	....	1,707,171	....	....
Hides and skins, other than furs....pounds	537,768,098	102,476,327	25,246,800	3,158,495
Meat: Beef.... "	....		233,924,626	21,926,463
Mutton.... "	....	....	3,595,543	349,875
Pork.... "	....	....	....	115,110,708
Sausage and sausage meat.... "	....	182,982	8,036,591	1,045,834
Other, incl. meat extracts....	....	1,176,010	....	....
Total meat....	....	1,358,992	....	161,434,714

Lard ... pounds	...	...	532,255,865	52,090,441
Lard compounds ... "	...	...	62,522,888	5,183,689
Oils, oleo oil ... "	*	*	126,467,124	13,434,018
Oleomargarine (imitation butter) .. "	...	...	3,627,425	372,567
Rennets ...	...	102,142	...	...
Sausage casings ... pounds	4,923,768	2,385,715	36,496,326	5,034,714
Stearin ... "	4,913,090	448,950	...	...
All other ...	...	...	...	1,497,993
Total packing-house products ...	...	117,270,572	...	161,434,714
Total animal matter ...	...	244,037,531	...	186,215,298
B. Vegetable Matter.				
Argols, or wine lees ... pounds	23,661,078	2,225,180	...	...
Broom corn ... long tons	1,346	157,969	3,320	461,110
Cider ... gallons	*	*	63,882	10,460
Cocoa ... pounds	145,968,945	15,931,556	} ...	514,266
Chocolate ... "	2,816,901	658,844		
Coffee ... "	885,201,247	117,826,543	42,248,460	7,170,758
Coffee substitutes ... "	755,722	47,930	...	...
Cotton ... "	109,780,071	20,217,581	5,535,125,429	565,849,271
Curry and curry powder ...	...	10,441	...	...
Fibers, vegetable (exclusive of cotton) ... pounds	...	34,462,866	...	...
Flavoring extracts and fruit juices ...	...	...	...	173,402
Flowers, natural ...	...	15,018	...	38,238
Forest products, total ...	...	172,523,465	...	108,122,254
Fruit juices ... gallons	*	*	...	...

* Not stated.

IMPORTS AND EXPORTS OF AGRICULTURAL PRODUCTS, 1911-1912.

(*Continued.*)

	Imports.		Exports.	
	Quantity.	Value.	Quantity.	Value.
B. VEGETABLE MATTER—*Continued.*				
Fruits and Nuts.		Dollars.		Dollars.
Fruits, fresh or dried	....	28,613,273	....	26,205,367
" preserved	....	936,107	....	4,149,333
Nuts	....	15,828,003	....	608,938
Total	....	45,377,333	....	30,963,638
Ginger, preserved or pickled ... pounds	468,329	30,139	....	....
Ginseng ... "	....	....	155,308	1,119,301
Glucose and grape-sugar ... "	....	....	171,156,259	3,916,897
Grain and Grain Products.				
Grain: Barley ... bushels	....	*	1,585,242	1,267,999
Buckwheat ... "	....	....	180	147
Corn (maize) ... "	53,425	47,936	40,038,795	28,957,450
Oats ... "	2,622,357	1,053,470	2,171,503	1,135,635
Rye ... "	....	*	5,548	4,844
Wheat ... "	2,699,130	2,212,887	30,160,212	28,477,584
Total grain ... "	5,374,912	3,314,293	73,961,480	59,843,659

* Included in "Other grain products."

Grain products: Macaroni, vermicelli, etc. pounds	108,231,028	4,738,937		
Meal and flour		665,346		52,912,806
Bran middlings, etc. . long tons			144,504	4,226,173
Malt . bushels	3,771	5,098	76,696	86,323
Dist. and brewery refuse l. tons.			73,628	1,901,974
Breadstuff preparations				2,791,156
Other		3,418,685		1,333,560
Total grain products		9,110,819		63,261,992
Total grain and grain products		12,425,112		123,095,651
Grasses, dried				*
Hay . long tons	699,004	6,473,230	59,730	1,039,040
Hops . pounds	2,991,125	2,231,348	12,190,663	4,648,505
Indigo "	7,658,067	1,153,142		
Licorice-root "	74,582,225	1,309,789		
Liquors, Alcoholic.				
Distilled spirits . proof-gallons	3,650,736	6,463,228	1,684,580	2,274,330
Malt liquors "	7,175,505	3,279,926		1,161,319
Wines . gallons		9,591,451	957,120	366,260
Total alcoholic liquors		19,334,605		3,801,909
Malt extract		8,639		
Nursery stock		2,999,544		413,255
Oil-cakes . tons	8,480	204,746	985,609	[illegible]8,228,705
Oils, vegetable, fixed or expressed		23,242,463		25,164,136
" " volatile or essential		3,592,280		744,795
Total vegetable oils		26,834,743		26,908,931

* Not stated.

IMPORTS AND EXPORTS OF AGRICULTURAL PRODUCTS, 1911-1912.
(*Continued.*)

	Imports.		Exports.	
	Quantity.	Value.	Quantity.	Value.
B. VEGETABLE MATTER—*Continued.*		Dollars.		Dollars.
Opium, crude..........pounds	399,837	2,437,403	....	....
Rice, rice-meal, etc.......... "	190,063,331	4,435,025	....	1,151,616
Root-beer..........dozen quarts	....	....	*	*
Roots, herbs, barks, etc..........	....	....	....	549,877
Sago, tapioca, etc..........	....	1,674,725	....	....
Seeds.				
Clover..........bushels	38,551,137	6,099,136	1,874,682	317,772
Cotton..........pounds	....	....	64,060,776	727,100
Flaxseed..........bushels	6,841,806	12,995,250	4,323	12,160
Grass-seed..........pounds	24,072,821	1,400,077	....	1,155,520
Sugar beet.......... "	11,389,394	1,103,357	....	....
Other seeds..........	....	2,962,817	....	686,250
Total..........	....	25,641,172	....	2,898,802
Spices..........pounds	63,116,548	5,974,170	....	74,023
Starch.......... "	15,841,437	478,465	83,644,749	1,965,401
Straw and grass..........long tons	10,172	56,702	1,030	11,559
Sugar and Molasses.				
Molasses..........gallons	28,828,213	1,197,878	9,513,441	984,636
Sirup.......... "	....	....	19,146,986	2,539,055
Sugar: Raw..........pounds	4,089,633,978	115,197,954	} 79,594,034	....
Refined.......... "	5,984,415	317,125		3,681,072
Total sugar.......... "	4,104,618,393	115,515,079	79,594,034	3,681,072
Total sugar and molasses..........	....	116,712,957	....	7,204,763

Tea.....pounds	101,406,816	18,207,141	.....	.....
Teasels.....	.....	16,998	.....	*
Tobacco.....pounds	54,740,380	31,925,584	379,845,320	43,251,857
Vanilla beans..... "	841,628	2,025,153	.....	.....
Vegetables fresh or dried.....bushels	.....	13,501,824	1,891,843	2,732,895
" prepared or preserved.....	.....	5,043,049	.....	3,811,223
Total vegetables.....	.....	18,544,873	.....	6,544,118
Vinegar.....gallons	360,524	81,899	185,580	37,770
Wafers, unmedicated.....	.....	29,593	.....	.....
Wax, vegetable.....pounds	4,665,828	1,080,200	.....	.....
Yeast.....	.....	.....	.....	175,347
Total vegetable matter, including forest products.....	.....	711,943,405	.....	970,340,724
Total agricultural imports or exports (including forest products).....	.....	955,980,936	.....	1,156,556,022
Total agricultural imports or exports (excluding forest products)	.....	783,457,471	.....	1,048,433,768

* Not stated.

DOMESTIC EXPORTS OF BUTTER AND CHEESE, 1870-1912.

(U. S. Dept. of Agriculture.)

Year.	Butter. Pounds.	Butter. Value.	Cheese. Pounds.	Cheese. Value.
1870	2,019,288	$592,229	57,296,327	$8,881,934
1875	6,360,827	1,506,996	101,010,853	13,659,603
1880	39,236,658	6,690,687	127,553,907	12,171,720
1885	21,683,148	3,643,646	111,992,990	10,444,409
1890	29,748,042	4,187,489	95,376,053	8,591,042
1895	5,598,812	915,533	60,448,421	5,497,539
1900	18,266,371	3,143,509	48,419,353	4,943,609
1905	10,071,487	1,648,281	10,134,424	1,084,044
1910	3,140,545	785,771	2,846,709	441,017
1911	4,877,797	1,059,432	10,366,605	1,288,279
1912	6,092,235	1,468,432	6,337,559	898,035

EXPORTS OF DAIRY PRODUCTS FROM CANADA, 1870-1910.

(The Canada Year-Book.)

Year.	Butter. Quantity.	Butter. Value.	Cheese. Quantity.	Cheese. Value.
	Pounds.		Pounds.	
1870	12,260,887	$2,353,570	5,827,782	$ 674,486
1875	9,268,044	2,337,324	32,342,030	3,886,226
1880	18,535,362	3,058,069	40,368,678	3,893,366
1885	7,330,788	1,430,905	79,655,367	8,265,240
1890	1,951,585	340,131	94,260,187	9,372,212
1895	3,650,258	697,476	146,004,650	14,253,002
1900	25,259,737	5,122,156	185,984,430	19,856,324
1901	16,335,528	3,295,663	195,926,397	20,696,051
1902	27,855,978	5,660,541	200,946,401	19,686,291
1903	34,128,944	6,954,618	229,099,925	24,712,943
1904	24,568,001	4,724,155	233,980,716	24,184,566
1905	31,764,303	5,930,379	215,733,259	20,300,500
1906	34,031,525	7,075,539	215,834,543	24,433,169
1907*	18,078,508	4,011,609	178,141,567	22,006,584
1908	4,786,954	1,068,703	189,710,463	22,887,237
1909	6,326,355	1,521,436	164,907,139	20,384,666
1910	4,615,380	1,010,274	180,859,886	21,607,692

* Nine months.

THE FERTILIZER INDUSTRY OF THE UNITED STATES. (U. S. Department of Agriculture.)

	Tons (of 2000 lbs.).	Value (wholesale).
Commercial fertilizers sold in 1896,		
in 23 Eastern and Central States	1,624,063	$32,301,582
in rest of United States	270,854	5,387,287
Total for the United States	1,894,917	$37,688,869
Census returns, 1890, value of fertilizers purchased:		(retail)
North Atlantic Division	....	11,449,069
South Atlantic "	....	18,759,139
North Central "	....	3,067,515
South Central "	....	4,952,013
Western "	....	241,862
Total for the United States...	....	$38,469,598

IMPORTS AND EXPORTS OF FERTILIZERS IN 1896. (U. S. Treasury Department.)

Imports.			Exports.		
Tons.	Value.	Value per Ton.	Tons.	Value.	Value per Ton.
375,733.93	$7,376,615	$19.04	514,143	$4,400,593	$8.56

IMPORTS OF FERTILIZERS AND FERTILIZER MATERIALS, 1896.

Articles.	Tons.	Value.	Value per Ton.
Ammonia, sulfate of	12,270.70	$480,971	$39.20
Apatite	434.00	3,030	6.98
Ashes, wood and lye of, and beet-root ashes	....	67,394	....
Blood, dried	....	1,014*	....
Bone-dust or animal carbon, and bone-ash, fit only for fertilizing purposes	2,983.00	37,992	12.74
Bones, crude, burned, calcined, ground or steamed	....	154,610	....
Cotton-seed meal and cake..........	325.61	3,170	9.74
Guano	5,072.29	52,697	10.39
Kieserite, cyanite, and kainit...............	67,192.91	320,765	4.77
Lime.......................................	21,403.02	76,302	3.57
Oil-cake	8,911.50	52,867	5.93
Phosphates, crude or native.................	20,562.29	153,370	7.46
Potash, muriate of.........................	43,438.35	1,372,743	31.60
Potash, sulfate of.........................	7,423.67	269,810	36.34
Soda, nitrate of, or cubic nitrate......... ...	145,456.64	3,870,734	26.61
All substances, not otherwise specified......	40,259.95	460,160	11.43
Total.............................. ...	375,733.93	$7,376,615	$19.64

* In 1895.

IMPORTS AND EXPORTS OF AGRICULTURAL PRODUCTS, 1911-1912.

(*Continued.*)

	Imports.		Exports.	
	Quantity.	Value.	Quantity.	Value.
A. ANIMAL MATTER—*Continued.*				
Fibers, Animal.		Dollars.		Dollars.
Silk....pounds	26,584,962	69,541,672	71,132	16,080
Wool, etc.... "	193,400,713	33,078,342	*	*
Total....	219,985,675	102,620,014	71,132	16,080
Gelatin....pounds	783,668	181,461	....	....
Glue.... "	7,534,322	776,696	3,059,952	314,909
Honey....gallons	115,040	62,684	....	212,652
Packing-house Products.				
Bones, hoofs, horns, etc....	....	1,038,653	....	162,009
Bristles....pounds	3,461,975	3,047,027	....	*
Grease, and all soap stock....	....	963,205	....	4,486,329
Hair....pounds	16,176,983	1,025,421	....	1,426,111
Hide cuttings and other glue stock....	....	1,707,171	....	....
Hides and skins, other than furs....pounds	537,768,098	102,476,327	25,246,800	3,158,495
Meat: Beef.... "	....	....	233,924,626	21,926,463
Mutton.... "	....	....	3,595,543	349,875
Pork.... "	....	....	....	115,110,708
Sausage and sausage meat.... "	....	182,982	8,036,591	1,045,834
Other, incl. meat extracts....	....	1,176,010	....	....
Total meat....	....	1,358,992	....	161,434,714

Lard	pounds			532,255,865	52,090,441
Lard compounds	"			62,522,888	5,183,689
Oils, oleo oil	"	*	*	126,467,124	13,434,018
Oleomargarine (imitation butter)	"			3,627,425	372,567
Rennets			102,142		
Sausage casings	pounds	4,923,768	2,385,715	36,496,326	5,034,714
Stearin	"	4,913,090	448,950		
All other					1,497,993
Total packing-house products			117,270,572		161,434,714
Total animal matter			244,037,531		186,215,298
B. Vegetable Matter.					
Argols, or wine lees	pounds	23,661,078	2,225,180		
Broom corn	long tons	1,346	157,969	3,320	461,110
Cider	gallons	*	*	63,882	10,460
Cocoa	pounds	145,968,945	15,931,556		514,266
Chocolate	"	2,816,901	658,844		
Coffee	"	885,201,247	117,826,543	42,248,460	7,170,758
Coffee substitutes	"	755,722	47,930		
Cotton	"	109,780,071	20,217,581	5,535,125,429	565,849,271
Curry and curry powder			10,441		
Fibers, vegetable (exclusive of cotton)	pounds		34,462,866		
Flavoring extracts and fruit juices					173,402
Flowers, natural			15,018		38,238
Forest products, total			172,523,465		108,122,254
Fruit juices	gallons	*	*		

* Not stated.

IMPORTS AND EXPORTS OF AGRICULTURAL PRODUCTS, 1911-1912.

(Continued.)

	Imports.		Exports.	
	Quantity.	Value.	Quantity.	Value.
B. VEGETABLE MATTER—*Continued.*				
Fruits and Nuts.		Dollars.		Dollars.
Fruits, fresh or dried	....	28,613,273	....	26,205,367
" preserved	....	936,107	....	4,149,333
Nuts	....	15,828,003	....	608,938
Total	....	45,377,333	....	30,963,638
Ginger, preserved or pickled ... pounds	468,329	30,139	....	....
Ginseng ... "	....	....	155,308	1,119,301
Glucose and grape-sugar ... "	....	....	171,156,259	3,916,897
Grain and Grain Products.				
Grain: Barley ... bushels	....	*	1,585,242	1,267,999
Buckwheat ... "	....	....	180	147
Corn (maize) ... "	53,425	47,936	40,038,795	28,957,450
Oats ... "	2,622,357	1,053,470	2,171,503	1,135,635
Rye ... "	....	*	5,548	4,844
Wheat ... "	2,699,130	2,212,887	30,160,212	28,477,584
Total grain ... "	5,374,912	3,314,293	73,961,480	59,843,659

* Included in "Other grain products."

Grain products: Macaroni, vermicelli, etc. pounds	108,231,028	4,738,937	....	....
Meal and flour............	....	665,346	....	52,912,806
Bran middlings, etc...long tons	....	....	144,504	4,226,173
Malt..................bushels	3,771	5,098	76,696	86,323
Dist. and brewery refuse. l. tons.	....	....	73,628	1,901,974
Breadstuff preparations.......	....	....	....	2,791,156
Other.....................	....	3,418,685	....	1,333,560
Total grain products............	....	9,110,819	....	63,261,992
Total grain and grain products....	....	12,425,112	....	123,095,651
Grasses, dried..............	....	....	....	*
Hay......................long tons	699,004	6,473,230	59,730	1,039,040
Hops......................pounds	2,991,125	2,231,348	12,190,663	4,648,505
Indigo.................... "	7,658,067	1,153,142	....	....
Licorice-root............. "	74,582,225	1,309,789	....	....
Liquors, Alcoholic.				
Distilled spirits..............proof-gallons	3,650,736	6,463,228	1,684,580	2,274,330
Malt liquors............. "	7,175,505	3,279,926	....	1,161,319
Wines........................gallons	....	9,591,451	957,120	366,260
Total alcoholic liquors..........	....	19,334,605	....	3,801,909
Malt extract..................	....	8,639	....	....
Nursery stock................	....	2,999,544	....	413,255
Oil-cakes.......................tons	8,480	204,746	985,609	[illegible]8,228,705
Oils, vegetable, fixed or expressed......	....	23,242,463	....	26,164,136
" " volatile or essential..........	....	3,592,280	....	744,795
Total vegetable oils............	....	26,834,743	....	26,908,931

* Not stated.

IMPORTS AND EXPORTS OF AGRICULTURAL PRODUCTS, 1911-1912.

(*Continued.*)

	Imports.		Exports.	
	Quantity.	Value.	Quantity.	Value.
B. VEGETABLE MATTER—*Continued.*		Dollars.		Dollars.
Opium, crude.......pounds	399,837	2,437,403	....	....
Rice, rice-meal, etc....... "	190,063,331	4,435,025	....	1,151,616
Root-beer.......dozen quarts	....	....	*	*
Roots, herbs, barks, etc.......	....	*	....	549,877
Sago, tapioca, etc.......	....	1,674,725	....	....
Seeds.				
Clover.......bushels	38,551,137	6,099,136	1,874,682	317,772
Cotton.......pounds	....	....	64,060,776	727,100
Flaxseed.......bushels	6,841,806	12,995,250	4,323	12,160
Grass-seed.......pounds	24,072,821	1,400,077	....	1,155,520
Sugar beet....... "	11,389,394	1,103,357	....	....
Other seeds.......	....	2,962,817	....	686,250
Total.......	....	25,641,172	....	2,898,802
Spices.......pounds	63,116,548	5,974,170	....	74,023
Starch....... "	15,841,437	478,465	83,644,749	1,965,401
Straw and grass.......long tons	10,172	56,702	1,030	11,559
Sugar and Molcsses.				
Molasses.......gallons	28,828,213	1,197,878	9,513,441	984,636
Sirup....... "	....	....	19,146,986	2,539,055
Sugar: Raw.......pounds	4,089,633,978	115,197,954	79,594,034	....
Refined....... "	5,984,415	317,125		3,681,072
Total sugar....... "	4,104,618,393	115,515,079	79,594,034	3,681,072
Total sugar and molasses.......	....	116,712,957	....	7,204,763

Tea.......pounds	101,406,816	18,207,141	....	....
Teasels.......	....	16,998	....	*
Tobacco.......pounds	54,740,380	31,925,584	379,845,320	43,251,857
Vanilla beans....... "	841,628	2,025,153	....	....
Vegetables fresh or dried.......bushels	....	13,501,824	1,891,843	2,732,895
" prepared or preserved.......	....	5,043,049	....	3,811,223
Total vegetables.......	....	18,544,873	....	6,544,118
Vinegar.......gallons	360,524	81,899	185,580	37,770
Wafers, unmedicated.......	....	29,593	....	....
Wax, vegetable.......pounds	4,665,828	1,080,200	....	....
Yeast.......	....	....	....	175,347
Total vegetable matter, including forest products.......	....	711,943,405	....	970,340,724
Total agricultural imports or exports (including forest products).......	....	955,980,936	....	1,156,556,022
Total agricultural imports or exports (excluding forest products)	....	783,457,471	....	1,048,433,768

* Not stated.

EDUCATIONAL INSTITUTIONS IN THE UNITED STATES AND CANADA HAVING COURSES IN AGRICULTURE. (U. S. Department of Agriculture.)

State.	Name of Institution	Locality.
Alabama	Alabama Polytechnic Institute	Auburn
	Agricultural and Mechanical College for Negroes	Normal
Arizona	University of Arizona	Tucson
Arkansas	University of Arkansas	Fayetteville
California	University of California	Berkeley
Colorado	State Agricultural College	Fort Collins
Connecticut	Conn. Agricultural College	Storrs
Delaware	Delaware College	Newark
	State College for Colored Stud'ts.	Dover
Florida	University of Florida	Gainesville
	Florida State Normal and Industrial College	Tallahassee
Georgia	State College of Agriculture and Mechanic Arts	Athens
	State Industrial College	Savannah
Idaho	University of Idaho	Moscow
Illinois	University of Illinois	Urbana
Indiana	Purdue University	Lafayette
Iowa	State College of Agriculture and the Mechanic Arts	Ames
Kansas	Kansas State Agricultural College	Manhattan
Kentucky	Agricultural and Mechanical College	Lexington
	State Normal School for Colored Students	Frankfort
Louisiana	State University and Agricultural and Mechanical College	Baton Rouge
	Southern University and Agricultural and Mechanical College	New Orleans
Maine	The University of Maine	Orono
Maryland	Maryland Agricultural College	College Park
	Princess Anne Academy, Eastern Br., Maryland Agricul. Coll.	Princess Anne
Massachusetts	Massachusetts Agricultural College	Amherst
Michigan	Michigan State Agricultural College	Agricultural College
Minnesota	The University of Minnesota	Univ. Farm, S. Paul
Mississippi	Agricultural and Mechanical College	Agricultural College
	Alcorn Agricultural and Mechanical College	Alcorn
Missouri	The University of Missouri	Columbia
	Lincoln Institute	Jefferson City
Montana	College of Agriculture and Mechanic Arts	Bozeman
Nebraska	The University of Nebraska	Lincoln
Nevada	Nevada State University	Reno
New Hampshire	College of Agriculture and Mechanic Arts	Durham

EDUCATIONAL INSTITUTIONS—(*Continued*).

State.	Name of Institution.	Locality.
New Jersey	Rutgers Scientific School	New Brunswick
New Mexico	College of Agriculture and Mechanic Arts	State College
New York	Cornell University	Ithaca
North Carolina	College of Agriculture and Mechanic Arts	W. Raleigh
	Agricultural and Mechanical College for the Colored Race	Greensboro
North Dakota	North Dakota Agricultural College	Agricultural College
Ohio	Ohio State University	Columbus
Oklahoma	Agricultural and Mechanical College	Stillwater
	Agricultural and Normal University	Langston
Oregon	Oregon State Agricultural College	Corvallis
Pennsylvania	Pennsylvania State College	State College
Porto Rico	University of Porto Rico	Mayaguez
Rhode Island	College of Agriculture and Mechanic Arts	Kingston.
South Carolina	Clemson Agricultural College	Clemson College
	Colored Normal, Industrial, Agricultural, and Mechanical College of South Carolina	Orangeburg
South Dakota	South Dakota Agricultural College	Brookings.
Tennessee	University of Tennessee	Knoxville
Texas	State Agricultural and Mechanical College of Texas	College Station
	Prairie View State Normal School	Prairie View
Utah	Agricultural College of Utah	Logan
Vermont	University of Vermont and State Agricultural College	Burlington
Virginia	Virginia Agricultural and Mechanical College and Polytechnic Institute	Blacksburg
	Hampton Normal and Agricultural Institute	Hampton
Washington	The State College of Washington	Pullman
West Virginia	West Virginia University	Morgantown
	West Virginia Colored Institute	Institute
Wisconsin	University of Wisconsin	Madison
Wyoming	University of Wyoming	Laramie

AMERICAN VETERINARY COLLEGES.

CALIFORNIA VETERINARY COLLEGE, San Francisco, Cal.

NATIONAL VETERINARY COLLEGE, Washington, D. C.

CHICAGO VETERINARY COLLEGE, Chicago, Ill.

McKILLIP VETERINARY COLLEGE, Chicago, Ill.

VETERINARY DEPARTMENT, IOWA STATE AGRICULTURAL COLLEGE, Ames, Iowa.

SCHOOL OF VETERINARY MEDICINE, HARVARD UNIVERSITY, Boston, Mass.

KANSAS CITY VETERINARY COLLEGE, Kansas City, Mo.

AMERICAN VETERINARY COLLEGE, UNIVERSITY OF THE STATE OF NEW YORK, New York City.

NEW YORK COLLEGE OF VETERINARY SURGEONS, New York City.

VETERINARY COLLEGE, CORNELL UNIVERSITY, Ithaca, N. Y.

SCHOOL OF VETERINARY MEDICINE, OHIO STATE UNIVERSITY, Columbus, O.

VETERINARY DEPARTMENT, UNIVERSITY OF PENNSYLVANIA, Philadelphia, Pa.

ONTARIO VETERINARY COLLEGE, Toronto, Canada.

McGILL UNIVERSITY, Department of Comparative Medicine, Montreal, P. Q., Canada.

LIST OF STATE VETERINARIANS.

State or Territory.	Post-office Address.	State or Territory.	Post-office Address.
Alabama	Auburn	Nevada	Reno
Arizona	Phœnix	New Hampshire	Concord
Arkansas	Fayetteville	New Jersey	Trenton
California	Sacramento	New Mexico	Las Vegas
Delaware	Wilmington	New York	Albany
Florida	Lake City	North Carolina	Raleigh
Georgia	Atlanta	North Dakota	Fargo
Idaho	Boisé	Ohio	Columbus
Illinois	Princeton	Oklahoma	Guthrie
Indiana	Lafayette	Oregon	Portland
Iowa	Forest City	Pennsylvania	Philadelphia
Kansas	Peabody	Rhode Island	Providence
Kentucky	Louisville	South Carolina	Clemson College
Louisiana	Baton Rouge	South Dakota	Huron
Maine	Saco	Tennessee	Murfreesboro
Maryland	Chestertown	Texas	Corpus Christi
Massachusetts	Boston	Utah	Heber City
Michigan	Saline	Vermont	Morrisville
Minnesota	Minneapolis	Virginia	Blacksburg
Mississippi	Agricul. College	Washington	Pullman
Missouri	Columbia	West Virginia	Charleston
Montana	Helena	Wisconsin	Madison
Nebraska	Lincoln	Wyoming	Cheyenne

DAIRY SCHOOLS IN THE UNITED STATES AND CANADA.

State or Province.	Location.	State or Province.	Location.
Alabama	Tuskegee	North Carolina	Raleigh
Colorado	Fort Collins	North Dakota	Fargo
Connecticut	Storrs	Ohio	Columbus
Georgia	Experiment	Oregon	Corvallis
Idaho	Moscow	Pennsylvania	State College
Illinois	Urbana	South Dakota	Brookings
Indiana	Lafayette	Texas	College Station
Iowa	Ames	Utah	Logan
Kansas	Manhattan	Vermont	Burlington
Maine	Orono	Virginia	Blacksburg
Maryland	College Park	Washington	Pullman
Massachusetts	Amherst	Wisconsin	Madison
Michigan	Agricultural Col.	Ontario	Kingston
Minnesota	St.AnthonyPark	"	Guelph
Mississippi	Agricultural Col.	"	Strathroy
Missouri	Columbia	Quebec	St. Hyacinthe
Nebraska	Lincoln	New Brunswick	Sussex
New Hampshire	Durham	Nova Scotia	Nappan.
New York	Ithaca	Manitoba	Winnipeg

SCHOOLS OF FORESTRY.

YALE FOREST SCHOOL, YALE UNIVERSITY, New Haven, Conn.

BILTMORE FOREST SCHOOL, Biltmore, N. C.

UNIVERSITY OF MICHIGAN FOREST SCHOOL, Ann Arbor, Mich.

HOWARD UNIVERSITY FOREST SCHOOL, Cambridge, Mass.

IOWA STATE COLLEGE OF AGRICULTURE AND MECHANICAL ARTS, Forestry Course, Ames, Iowa.

UNIVERSITY OF MAINE, Department of Forestry, Orono, Me.

MICHIGAN AGRICULTURAL COLLEGE, Department of Forestry, Agricultural College P. O., Mich.

UNIVERSITY OF MINNESOTA, Forest School, St. Anthony Park, Minn.

UNIVERSITY OF CALIFORNIA, Forest School, Berkeley, Cal.

AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

State.	Location.	Year Established.
Alabama (College)	Auburn	1883
Alabama (Canebrake)	Uniontown	1886
Alabama (Tuskegee)	Tuskegee	1897
Alaska	Sitka Institute	1899
Arizona	Tucson	1889
Arkansas	Fayetteville	1887
California	Berkeley	1875
Colorado	Fort Collins	1879
Connecticut (State)	New Haven	1877
Connecticut (Storrs)	Storrs	1887
Delaware	Newark	1888
Florida	Gainesville	1888
Georgia	Experiment	1888
Guam	Island of Guam	1908
Hawaii	Honolulu	1898
Idaho	Moscow	1892
Illinois	Urbana	1888
Indiana	Lafayette	1888
Iowa	Ames	1888
Kansas	Manhattan	1888
Kentucky	Lexington	1885
Louisiana (Sugar)	New Orleans	1885
Louisiana (State)	Baton Rouge	1886
Louisiana (North)	Calhoun	1887
Maine	Orono	1885
Maryland	College Park	1888
Massachusetts	Amherst	1882
Michigan	East Lansing	1888
Minnesota	Univ. Farm, St. Paul	1888
Mississippi	Agricultural College	1888
Missouri (College)	Columbia	1883
Missouri (Fruit)	Mountain Grove	1900
Montana	Bozeman	1893
Nebraska	Lincoln	1884
Nevada	Reno	1888
New Hampshire	Durham	1886
New Jersey (State)	New Brunswick	1880
New Jersey (College)	New Brunswick	1888
New Mexico	State College	1889
New York (State)	Geneva	1882
New York (Cornell)	Ithaca	1879
North Carolina	Raleigh	1877
North Dakota	Agricultural College	1890
Ohio	Wooster	1882
Oklahoma	Stillwater	1890
Oregon	Corvallis	1888
Pennsylvania	State College	1887
Porto Rico	Mayaguez	1902
Rhode Island	Kingston	1888
South Carolina	Clemson College	1888
South Dakota	Brookings	1887
Tennessee	Knoxville	1882
Texas	College Station	1888
Utah	Logan	1890
Vermont	Burlington	1886
Virginia	Blacksburg	1888
Washington	Pullman	1891
West Virginia	Morgantown	1888
Wisconsin	Madison	1883
Wyoming	Laramie	1891

Canadian Experiment Stations.

CENTRAL EXPERIMENTAL FARM—Ottawa, Ont.

EXPERIMENTAL FARM—Nappan, N. S.
" " —Brandon, Manitoba.
" " —Indian Head, N. W. T.
" " —Agassiz, B. C.

EXPERIMENT STATION—Ontario Agricultural College, Guelph, Ont.

OFFICIALS IN CHARGE OF FARMERS' INSTITUTES.

(Farmers' Institute Specialist, U. S. Dept. of Agriculture, John Hamilton, Washington, D. C.)

State or Territory.	Address.	State or Territory.	Address.
Alabama	Auburn	Nevada	Reno
Alaska	Sitka	NewHampshire	Concord
Arizona	Tucson	New Jersey	Trenton
Arkansas	Fayetteville	New Mexico	Agricultural Coll.
California	Berkeley	New York	Fayetteville
Colorado	Fort Collins	North Carolina	Raleigh
Connecticut	N. Stonington	North Dakota	Bismarck
Delaware	Dover	Ohio	Columbus
Florida	Lake City	Oklahoma	Guthrie
Georgia	Atlanta	Oregon	Corvallis
Idaho	Moscow	Pennsylvania	Harrisburg
Illinois	Springfield	Rhode Island	Providence
Indiana	Lafayette	South Carolina	Clemson College
Iowa	Des Moines	South Dakota	Gary
Kansas	Manhattan	Tennessee	Nashville
Kentucky	Frankfort	Texas	College Station
Louisiana	Baton Rouge	Utah	Logan
Maine	Augusta	Vermont	Woodstock
Maryland	Benson	Virginia	Richmond
Massachusetts	Boston	Washington	Pullman
Michigan	Agricultural Coll.	West Virginia	Sunlight
Minnesota	Lynd	Wisconsin	Madison
Mississippi	Agricultural Coll.	Wyoming	Laramie
Missouri	Columbia	Ontario, Can	Toronto, Ont.
Montana	Bozeman	Manitoba, Can.	Brandon, Manit.
Nebraska	Lincoln		

VII. AGRICULTURAL AND DAIRY LITERATURE.

MORE IMPORTANT WORKS ON DAIRYING.

American.

Arnold, American Dairying. Rochester, N. Y., 1876. (Out of print.)

Conn, Practical Bacteriology, N. Y., 1907, 340 pp. $1.25.

Dean, Canadian Dairying. Toronto, 1903. 260 pp. $1.00.

Decker, Cheese Making: Cheddar, Swiss, Brick, Edam, etc. Fifth edition, by F. W. Woll. Madison, Wis., 1913. 211 pp. $1.75.

Decker, Elements of Dairying. Columbus, O., 1903. 114 pp. $1.00.

Eckles, Dairy Cattle and Milk Production. N. Y., 1911. $1.60.

Farrington-Woll, Testing Milk and its Products. Twenty-second edition. Madison, Wis., 1914. 297 pp. $1.25.

Flint, Milch Cows and Dairy Farming. Boston, 1888.

Grotenfelt-Woll, Modern Dairy Practice. Third edition, revised. New York, 1910. 286 pp. $2.00.

Gurler, The Farm Dairy. Chicago, 1908. 164 pp. $1.00.

Jensen-Pearson, Essentials of Milk Hygiene. Philadelphia, 1907. 275 pp. $2.50.

Lane, Business of Dairying. N. Y., 1909. $1.25.

Larsen and White, Dairy Technology. N. Y., 1913. $1.50.

Michels, Creamery Butter Making. Lansing, Mich., 1904. 271 pp. $1.00.

McKay-Larsen, Principles and Practice of Butter Making. New York, 1906. 329 pp. $1.50.

Monrad, ABC in Cheese Making. Winnetka, Ill. Second edition. 68 pp. 50 cents.

Monrad, ABC in Butter Making. Winnetka, Ill., 1899. 118 pp. 50 cents.

Monrad, Pasteurization and Milk Preservation. Winnetka, Ill. 78 pp. 50 cents.

Monrad, Cheese Making in Switzerland. Winnetka, Ill. 68 pp. 50 cents.

Rosenau, The Milk Question. Boston, 1912. 309 pp. $2.00.

Russell, Outlines of Dairy Bacteriology. Seventh edition. Madison, Wis., 1906. 190 pp. $1.00.

Snyder, Dairy Chemistry. New York, 1906. 190 pp. $1.00.

Schoenman, Butter-fat and Dividend Calculator. Madison, Wis., 1895. 66 pp. $2.00.

Van Slyke, Modern Methods of Testing Milk. New York, 1906. 214 pp. 75 cents.

Vye, Creamery Accounting. Delano, Minn., 1899. 42 pp. $1.00.

Ward, Pure Milk and the Public Health. Ithaca, N. Y., 1909. 218 pp.

Willard, Practical Dairy Husbandry. N. Y., 1877. 546 pp.

Wing, Milk and its Products. N. Y., 1912. 324 pp.

Winslow, The Production and Handling of Clean Milk. New York. 1907. 207 pp.

English.

Fleischmann, Book of the Dairy. London, 1896. 10s. 6d.

Richmond, Dairy Chemistry. London, 1899. 384 pp.

Sheldon, Dairy Farming. London. 570 pp. 4to.

Sheldon, The Farm and the Dairy. London, 1889. 154 pp. 2s. 6d.

Sheldon, British Dairying. 2d ed., 1896. 170 pp.

Aikman, Milk, its Nature and Composition. London, 1895. 180 pp.

Willoughby, Milk, its Production and Uses. London, 1904. 259 pp. $2.00.

Long, The Dairy Farm. London, 1889. 115 pp.

Matthews, Economics in Dairy Farming. London, 1903. 68 pp. $2.25.

Oliver, Milk, Cheese, and Butter. London, 1894. 362 pp.

Barthel, Milk and Dairy Products. London, 1910. 260 pp.

Freudenreich, Dairy Bacteriology. London, 1895. 115 pp.

Swithinbank and Newman, Bacteriology of Milk. London, 1904. 605 pp. $8.00.

Other European.

Martiny, Die Milch, I–II. Danzig, 1871. 438 and 366 pp.

Martiny, Kirne und Girbe. Berlin, 1895. 404 pp., 4to.

Martiny, Milchwirtschaftl. Taschenbuch. Published annually, Leipzig.

Fleischmann, Das Molkereiwesen. Braunschweig, 1876. 1074 pp.

Fleischmann, Lehrbuch d. Milchwirtschaft. Fourth edition. Leipzig, 1908. 536 pp.

Grimmer, Chemie und Physiologie der Milch. Berlin, 1910. 364 pp.

Sommerfeld, Handbuch der Milchkunde. Wiesbaden, 1909. 999 pp.

Stohmann, Die Milch- und Molkereiproducte. Braunschweig, 1898. 1031 pp.

Kirchner, Handbuch d. Milchwirtschaft. Fifth edition. Berlin, 1907. 700 pp.

Anderegg, Geschichte der Milchwirtschaft. Zurich, 1894. 207 pp.

v. Klenze, Handb. d. Käserei-Technik. Bremen, 1884. 643 pp.

Eugling, Praktische Käserei. Bremen, 1892. 260 pp.

Weigmann, Die Methoden der Milch-conservirung. Bremen, 1893. 72 pp.

Duclaux, Le Lait. Paris, 1887. 336 pp.

Duclaux, Principes de Laiterie. Paris. 370 pp.

Lézé, Les Industries de Lait. Paris, 1891. 647 pp.

Pouriau, La Laiterie. 5th ed. Paris, 1895. 898 pp.

Böggild, Mälkeribruget i Danmark. Third edition. Copenhagen, 1907. 627 pp.

A LIST OF SIXTY AGRICULTURAL AND HORTICULTURAL BOOKS.

Bailey, Cyclopedia of American Agriculture. N. Y., 1907–1909. 4 volumes.

Hunt, How to Choose a Farm. N. Y., 1906. 412 pp.

Bailey, Principles of Agriculture. N. Y., 1898. 300 pp.

Fream, Elements of Agriculture. 8th ed. London, 1911. 692 pp.

Warren, Elements of Agriculture. N. Y., 1909. 434 pp.

Webb, Advanced Agriculture. London, 1894. 672 pp.
Goff-Mayne, First Principles of Agriculture. N. Y., 1904. 248 pp.
Hall, Feeding of Crops and Stock. London, 1911. 298 pp.
Storer, Agriculture in some of its Relations with Chemistry. 7th ed. N. Y., 1897. 3 vols.
Voorhees, First Principles of Agriculture. N. Y., 1896. 212 pp.
Roberts, The Fertility of the Land. N. Y., 1897. 415 pp.
Voorhees, Fertilizers. N. Y., 1899. 335 pp.
Warington, Chemistry of the Farm. 21st ed. London, 1913. 247 pp.
Johnson, How Crops Feed. N. Y., 375 pp.
Johnson, How Crops Grow. N. Y., 1890. 416 pp.
Hunt, Cereals in America. N. Y., 1904. 421 pp.
Plumb, Indian Corn Culture. Chicago, 1895. 250 pp.
Woll, A Book on Silage. Revised ed., Chicago, 1900. 234 pp.
Allen, American Cattle. N. Y., 1881. 528 pp.
Wallace, Farm Live Stock of Great Britain. Edinburgh, 1907. 758 pp.
Craig, Judging Live Stock. 4th ed. Des Moines, Ia., 1902. 193 pp.
Plumb, Types and Breeds of Farm Animals. N. Y., 1906. 563 pp.
Marshall, Breeding Farm Animals. Chicago, 1911. 287 pp.
Day, The Horse, How to Breed and Rear Him. 2d ed. London, 1890. 453 pp.
Johnstone, The Horse Book. Chicago, 1908. 299 pp.
Armsby, Manual of Cattle Feeding. N. Y., 1887. 525 pp.
Henry, Feeds and Feeding. Madison, Wis., 1910. 613 pp.
Jordan, Feeding Animals. N. Y., 1901. 450 pp.
Craig, Sheep Farming in North America. N. Y., 1913. 302 pp.
Day, Productive Swine Husbandry. Philadelphia, 1913. 330 pp.
Dawson, The Hog Book. Chicago, 1911. 414 pp.
Harris, On the Pig. N. Y., 1889. 318 pp.
Collingwood, The Business Hen. N. Y., 1904. 125 pp.
Robinson, Principles and Practices of Poultry Culture. Boston, 1912. 611 pp.

Cook, Bee-keeper's Guide. Lansing, Mich., 1884. 4th ed. 337 pp.

Law, Farmer's Veterinary Adviser. Ithaca, N. Y., 1880. 426 pp.

Reynolds, Veterinary Studies. 328 pp. St. Anthony Park, Minn., 1903.

Hilgard, Soils. N. Y., 1906. 593 pp.

King, Physics of Agriculture. Madison, Wis., 1904. 604 pp.

King, The Soil. N. Y., 1903. 303 pp.

Elliott, Land Drainage. N. Y. 232 pp.

Ogden, Rural Hygiene. New York, 1911. 434 pp.

Wilcox, Irrigation Farming. N. Y., 1902. 494 pp.

Bailey, et al., Cyclopedia of American Horticulture, 4 vols. N. Y., 1902.

Goff, Principles of Plant Culture. 2d ed. Madison, Wis., 1898. 276 pp.

Bailey, The Nursery Book. 2d ed. N. Y., 1892. 304 pp.

Fletcher, How to Make a Fruit Garden. N. Y., 1905.

Rawson, Success in Market Gardening. N. Y., 1910. 271 pp.

Watts, Vegetable Gardening. New York, 1912.

Card, Bush Fruits. New York, 1899. 549 pp.

Fuller, Grape Culturist. N. Y. 218 pp.

Henderson, Practical Floriculture. N. Y., 1891. 325 pp.

Weed, Insects and Insecticides. Hanover, N. H., 1891. 281 pp.

Lodeman, The Spraying of Plants. N. Y., 1908. 399 pp.

Gifford, Practical Forestry. N. Y., 1902. 284 pp.

Graves, Principles of Handling Woodlands. N. Y., 1911. 325 pp.

Halsted, Barn Plans and Outbuildings. N. Y., 1903. 385 pp.

Bailey, The Farm and Garden Rule-Book. N. Y., 1911. 587 pp.

Adams, The Modern Farmer. San Francisco, 1899. 662 pp.

Roberts, The Farmers' Business Handbook. N. Y., 1903. 300 pp.

Carver, Rural Economics. N. Y., 1905. 327 pp.

Warren, Farm Management. N. Y., 1913. 590 pp.

Green, Law for the American Farmer. N. Y., 1911. 438 pp.

Butterfield, Chapters in Rural Progress. Chicago, 1908. 251 pp.

Carney, Country Life and the Country School. Chicago, 1912. 405 pp.

AMERICAN DAIRY PAPERS.

American Cheese-Maker. Grand Rapids, Mich. Monthly. 50 cents.

Chicago Dairy Produce. Chicago, Ill. Weekly, $1.50.

Creamery Journal. Waterloo, Ia. Monthly, $1.00.

Dairy Record, St. Paul, Minn. Weekly, $1.00.

Elgin Dairy Report. Elgin, Ill. Weekly, $1.00.

Guernsey Breeder's Journal. Peterboro, N. H. Monthly. $2.00.

The Jersey Bulletin and Dairy World. Indianapolis, Ind. Weekly, $1.00.

Hoard's Dairyman. Fort Atkinson, Wis. Weekly, $1.00.

Holstein-Friesian Register. Brattleboro, Vt. Semi-monthly, $1.50.

Holstein-Friesian World, Ithaca, N. Y. Semi-monthly, 50 cents.

Kimball's Dairy Farmer. Waterloo, Ia. Semi-monthly, 50 cents.

The Michigan Dairy Farmer. Detroit, Mich. Semi-monthly, $1.00.

The Milk Dealer. Milwaukee, Wis. Monthly, $1.00.

The Milk Reporter. Syracuse, N. Y. Monthly, $1.00.

New York Produce Review and American Creamery. New York City. Weekly, $1.00.

Practical Dairyman. New York City. Weekly, $1.00.

Pacific Dairy Review. San Francisco, Cal. Weekly, $1.00.

Canadian Dairyman. Toronto. Monthly, $1.00.

MAIN FOREIGN DAIRY PAPERS.

The Dairy. 144 Fleet Street, London, England. Monthly, 3s.

The Dairyman. 17 New Castle Street, Farringdon St., London, England.

The Dairy World and British Dairy Farmer. 310 Strand, London, England. Monthly, 3s.

Nordisk Mejeri-Tidning. Stockholm, Sweden. Weekly, 5 kr.

Mälkeritidende. Odense, Denmark. Weekly.

Milchwirtschaftliches Zentralblatt. Leipzig, Germany. Monthly.

Deutsche Molkerei-Zeitung. Berlin, Germany. Weekly, 9.20 mk.

Molkerei-Zeitung. Hildesheim, Germany. Weekly, 6 mk.

Oesterreich. Molkerei-Zeitung. Vienna, Austria. Semi-monthly, 6 mk.

L'Industrie Laitière. 33 Rue J. J. Rousseau, Paris, France. Weekly, 20 fr.

La Laiterie. 18 Rue des Martyrs, Paris. Bi-weekly, 13 fr.

Schweizerische Molkerei Zeitung. Zurich. Weekly, 6.60 fr.

Die Milch Industrie. Berne, Switzerland.

Revue Generale du Lait. Brussels. Semi-monthly, 16 fr.

New Zealand Dairyman, Wellington, N. Z. Monthly, 6s. 6d.

MAIN AMERICAN AGRICULTURAL AND HORTICULTURAL PAPERS.

American Agriculturist. New York City. Weekly, $1.00.

American Bee Journal. Chicago, Ill. Weekly, $1.00.

American Cultivator. Boston, Mass. Weekly, $2.50.

American Fertilizer. Philadelphia, Pa. Monthly, $2.00.

American Gardening. New York City. Semi-monthly, $1.00.

American Hay, Flour, and Feed Journal. N. Y. Monthly, $1.00.

American Poultry Journal. Chicago, Ill. Monthly, $1.00.

American Poultry World. Buffalo, N. Y. Monthly, 50 cents.

American Sheep Breeder and Wool Grower. Chicago, Ill. Monthly, $1.00.

American Sugar Industry and Beet-sugar Gazette. Chicago, Semi-monthly, $2.50.

American Swine Herd. Chicago, Ill. Monthly, 50 cents.

American Thresherman. Madison, Wis. Monthly, $1.00.

American Veterinary Review. New York City. Monthly, $3.00.

Acker- und Gartenbau Zeitung. Milwaukee, Wis. Weekly, $1.00.

Better Fruit. Hood River, Ore. Monthly, $1.00.

Breeders' Gazette. Chicago, Ill. Weekly, $1.00.

California Cultivator and Poultry Keeper. Los Angeles, Cal. Monthly, $1.00.

Canadian Horticulturist. Peterboro, Ont. Monthly, $1.00.

Chicago Live Stock World. Chicago, Ill. Daily, $3.00.

Colman's Rural World. St. Louis, Mo. Weekly, $1.00.

Connecticut Farmer. Hartford, Conn. Weekly, $1.50.

The Country Gentleman. Philadelphia, Pa. Weekly, $1.50.

Country Life in America. N. Y. Monthly, $4.00.

The Dakota Farmer. Aberdeen, S. D. Semi-monthly, $1.00.

Drover's Journal. Chicago, Ill. Weekly, $1.50.

Farm and Fireside. Springfield, O. Semi-monthly, 50 cents.

Farm and Home. Chicago, and Springfield, Mass. Semi-monthly, 50 cents.

The Farm Poultry. Boston, Mass. Monthly, 50 cents.

The Farmer. St. Paul, Minn. Semi-monthly, 50 cents.

Farm Implement News. Chicago. Weekly, $2.00.

The Farmers' Advocate. London, Ont. Weekly, $1.50.

Farmers' Guide. Huntington, Ind. Weekly, 75 cents.

The Farmer's Magazine. Montreal. Monthly, $2.00.

The Farmers' Tribune. Sioux City, Ia. Weekly, $1.00.

Farmers' Review. Chicago, Ill. Weekly, $1.25.

Farm, Field, and Fireside. Chicago, Ill. Weekly, $1.00.

Farm News. Springfield, Ohio. Monthly, 50 cents.

Farm, Stock, and Home. Minneapolis, Minn. Semi-monthly, 50 cents.

Farming. N. Y. Monthly, $1.00.

Farming World. Toronto, Canada. Weekly, $1.00.

The Farm Journal. Philadelphia, Pa. Monthly, 50 cents.

The Field Illustrated. N. Y. Weekly, $3.00.

Florida Agriculturist. De Land, Fla. Weekly, $2.00.

Flour and Feed. Milwaukee, Wis. Monthly, $1.00.

Garden Magazine. N. Y. Monthly, $1.00.

Gardening. Chicago, Ill. Semi-monthly, $2.00.

Horse Review. Chicago, Ill. Weekly, $2.00.

Indiana Farmer. Indianapolis, Ind. Weekly, $1.00.

The Homestead. Des Moines, Ia. Weekly, $1.00.

Irrigation Age. Chicago, Ill. Monthly, $2.00.

Journal of Agriculture. St. Louis, Mo. Weekly, $1.00.

Journal of Agriculture and Horticulture. Montreal, Canada. Monthly, $1.00.

Kansas Farmer. Topeka, Kan. Weekly, $1.00.

Kentucky Stock Farm. Lexington, Ky. Weekly, $2.00.

Live Stock and Dairy Journal. Sacramento, Cal. Monthly, 75 cents.

Live Stock Journal. Chicago, Ill. Weekly, $1.00.

Live Stock Report. Chicago, Ill. Weekly.

Louisiana Planter and Sugar Manufacturer. New Orleans, La. Weekly, $3.00.

Market Growers' Journal. Louisville, Ky. Semi-monthly. $1.00.

Massachusetts Ploughman, Boston. Weekly, $2.00.

Michigan Farmer. Detroit, Mich. Weekly, $1.00.

Mirror and Farmer. Manchester, N. H. Weekly, $1.00.

Montana Stockman and Farmer. Helena, Mont. Semi-monthly, $2.00.

National Grange Monthly. Westfield, Mass. 50 cents.

National Stockman and Farmer. Pittsburgh, Pa. Weekly, $1.50.

Nebraska Farmer. Lincoln, Neb. Weekly, $1.25.

New England Farmer. Boston, Mass. Weekly, $2.00.

New England Homestead. Springfield, Mass. Weekly, $1.00.

The Nor'-west Farmer. Winnipeg, Manitoba. Weekly, $1.50.

Northwestern Agriculturist. Minneapolis, Minn. Semi-monthly, 50 cents.

Ohio Farmer. Cleveland, Ohio. Weekly, $1.00.

Ohio Poultry Journal. Dayton, Ohio. Monthly, $1.00.

Orange Judd Farmer. Chicago, Ill. Weekly, $1.00.

Orchard and Farm. San Francisco, Cal. Monthly, $1.00.

Pacific Rural Press. San Francisco, Cal. Weekly, $3.00.

Poultry Husbandry. Waterville, N. Y. Monthly, 50 cents.

Practical Farmer. Philadelphia. Weekly, $1.00.

Prairie Farmer. Chicago, Ill. Weekly, $1.00.

Ranch. Seattle, Wash. Semi-monthly, $1.00.

Rural Californian. Los Angeles, Cal. Monthly, $1.50.

Rural New Yorker. New York City. Weekly, $1.00.

The Shepherds' Journal. Chicago, Ill. Monthy, 50 cents.

Southern Cultivator. Atlanta, Ga. Monthly, $1.00.

Southern Planter. Richmond, Va. Monthly, $1.00.
Successful Poultry Journal. Chicago, Ill. Monthly, 50 cents.
Sugar-beet. Philadelphia. Quarterly, $2.00.
Swine-Breeders' Journal. Indianapolis, Ind. Semi-monthly $1.00.
Twentieth Century Farmer. Omaha, Neb. Weekly, $1.00.
Texas Stockman. San Antonio, Tex. Weekly, $1.00.
Turf, Field, and Farm. New York City. Weekly, $5.00.
Wallace's Farmer. Des Moines, Ia. Weekly, $1.00.
Western Swine-breeder. Lincoln, Neb. Monthly, 50 cents.
Wisconsin Agriculturist. Racine, Wis. Weekly, 75 cents.
Wool Markets and Sheep. Chicago, Ill. Weekly, $1.00.

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